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A Monthly Popular Journal of Knowledge

Vol. XIV. No. 161. MAY, 1933 PRICE 1s. NET

FROM AN ANCIENT CHINESE MANUSCRIPT.
(See page 161.)

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DISCOVERY

A Monthly Popular Journal of Knowledge

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Trustees: Sir J. J. Thomson, O.M., F.R.S., Sir F. G. Kenyon, K.C.B., F.B.A., Professor A. C. Seward, Sc.D., F.R.S., Professor R. S. Conway, Litt.D., F.B.A.

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Notes of the Month.

We are privileged to publish two articles of unusual interest in this number. As announced last month, Professor R. S. Conway discusses the mosaic of Vergil discovered thirty years ago in North Africa, and the article is illustrated by a full-page reproduction, suitable for framing. In these notes last month it was stated that the illustration appears for the first time in any English publication. The statement needs qualifying. Professor Conway was, of course, familiar with the excellent but small reproduction of the mosaic which is included in Dr. George F. Hill's "Illustrations of School Classics." But we imagine we are right in claiming that the illustration now presented to readers of *Discovery* is the first of its size and detail to be published in an English magazine. On that account it should be of unusual interest to classical students. We draw attention also to the article by the Master of Sempill on the Mount Everest Air Expedition. Readers familiar with conditions in the Himalaya will, perhaps, be most impressed by the fact that the aeroplanes passed over the peak of Mount Everest at a height of only a few hundred feet, some thousands of feet lower than was thought to be safe.

* * * * *

The Ideal Home Exhibition at Olympia was a reminder of the extent to which we are indebted to scientific research for the comforts and conveniences of modern life. On every hand were fresh examples of "science in the home." Special interest was taken in the "Rooms of the Scientists," which formed a remarkably complete "bird's-eye view" of the progress of science, from the villa of Archimedes at Syracuse to the sphere of the balloon in which Professor Piccard made his recent ascent into the stratosphere. Other scenes included Roger Bacon in prison, Lister's surgical ward at Glasgow Royal Infirmary, the tent in which Sir Ronald Ross experimented on the mosquito in relation to malaria, Darwin's study at Down House in which the "Origin of Species" was written, Faraday's laboratory at the Royal Institution, and the cabin of the Marchese Marconi's yacht *Elettra*. An interesting innovation at this year's exhibition was the demonstration of television in the fashion theatre, which naturally attracted much interest.

* * * * *

Another exhibition of television, at the Imperial College of Science, was probably of more importance to those who are taking more than a superficial interest in this fascinating science. It is mentioned more fully on another page. Progress in this country has been chiefly with the use of mechanical means; the image is "scanned" by a revolving metal disc perforated with square apertures in the form of a spiral. But in an alternative method, and one which many experts now favour, the cathode ray takes the place of mechanical methods. The image is produced by the rapid transit of a beam of electrons over a fluorescent screen. The demonstration of cathode ray television at the exhibition was of particular interest, since greater detail is possible by this means. Further progress on these lines will be closely watched.

* * * * *

Archaeological discoveries of great value are often made by accident. Such a case is reported from Sweden, where a treasure of coins and costly ornaments, probably that of a wealthy nobleman, has been turned up by the plough in Skaane, the most southerly province of Sweden. The discovery is described as one of the finest collections of antiquities ever found in Scandinavian soil. The coins date some three hundred years back, and the collection includes

*

ornaments of hand-wrought gilt-silver, decorated buckles, belt mountings and spangles of great beauty. Archaeologists consider that the ornaments belong to the best specimens of late Gothic silverwork existing in Sweden. The belt mountings were decorated by a master hand with garlands of acanthus and flowers, mostly carnations, strewn over its surface, while on one of them a Madonna standing under a baldachin on the crescent of the moon was exquisitely engraved. The collection has been purchased by the State Historical Museum of Sweden.

* * * * *

Research which is likely to be of immense value to the whaling industry has been carried out on the voyage of the *Discovery II*, which has circumnavigated the Antarctic and will shortly return to England. This is the first occasion on which any ship has cruised in the Antarctic in the depth of winter, and the *Discovery II* has covered a greater distance than any other Polar expedition. Important new information has been gathered about the distribution and migration of whales, and their rate of growth and reproduction. The new light which the investigations have thrown on the causes of good and bad whaling seasons should be of particular value to the industry. The voyage, which lasted a year, is a notable achievement in Polar navigation.

* * * * *

The belief that all the diseases to which man is subject can be traced in the last analysis to deficiency of nitrogen was expressed by Sir Frederick Keeble in a lecture to the Royal Institution. No plant was receiving as much nitrogen as it could do with, and the sea was also deficient. "The Nitrogen Hunger of the World" was Sir Frederick's theme, and he declared that it was a subject which required the voice of a poet to do it justice. Nitrogen is, of course, useless in its natural state; it is only of practical value when it is united with suitable elements. As Sir Frederick pointed out, until the present century the only means of challenging the independence of nitrogen were the thunderstorm and the nitrogen-fixing bacteria. Now, however, it is possible to compel nitrogen to enter into the fertile unions on which life depends.

* * * * *

The opposition between popular beliefs and science was the theme of a suggestive leading article in the *Times* last month. Dr. Frederick Dillon suggests that the importance of this opposition is even greater than the article would lead one to suppose. He points out that the headway lost in the spread of scientific ideas through popular bias is considerable, and in medicine in particular the amount of avoidable suffering perpetuated through the obstinate persistence of magic and animistic convictions is serious indeed. The remedy may lie not so much in the need for greater general respect for "science," as in a wider understanding of scientific method. This Dr. Dillon sums up as the insistence on accuracy in our knowledge of facts—including the ability to discriminate between a fact and an assumption—and the development of the capacity to estimate the value of evidence and the probability of hypotheses. If instruction in this subject were given in the schools it would help considerably to minimize the social loss that occurs at present from the widespread prevalence of error and bias, at least in medical science.

* * * * *

We are interested to learn that the British Association has received on loan from the Royal Society the barometer used by Darwin during the voyage of the *Beagle*. Down House, the scientist's home in Kent, already houses a remarkably complete collection of relics, and the barometer is a fitting addition. It is now in working order as Darwin had it, having been restored by Negretti and Zambra with the advice of the Meteorological Society. The instrument is of the straight type, contained in a wooden case three feet long, with a thermometer near the base. The barometer scale reads down to 18.2 inches, and this was suitable for use up to fairly high altitudes. Darwin is known to have carried it when ashore during the voyage. A double mercury cistern and locking arrangement is provided to allow the instrument to be carried without disturbance.

* * * * *

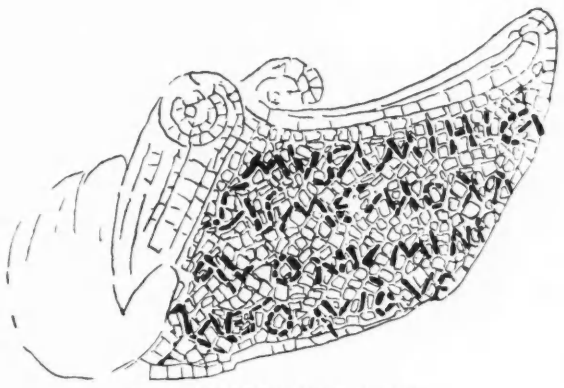
The moral standard of the Formosa "savage" is now remarkably high and such cruel practices as head-hunting have virtually ceased. But the danger of sporadic outbursts even now was mentioned by the Rev. W. H. Murray Walton in an address to the Royal Geographical Society on his recent visit to Formosa. Within three months of the lecturer's visit, at one police post over a hundred Japanese were murdered. Such incidents must certainly be exceptional. To the savage head-hunting seems to have no moral implication; on the contrary, it is by this means that the young man is able to prove his manhood. Mr. Walton pointed out that men are not allowed to take the heads of members of their tribe, but apart from this there are no game laws, no "close season." Chinese heads are considered a special trophy. Mr. Walton saw many examples of the thoroughness with which Japan is giving herself to the development of these primitive folk.

The Portrait of Vergil.

By R. S. Conway, Litt.D., D.Litt., F.B.A.

A mosaic discovered in North Africa contains a remarkable portrait which is believed to represent Vergil. The evidence for this conclusion, and the light it throws on the personality of the poet, are discussed by Professor Conway. The full-page picture (reproduced on page 143) appears for the first time in an English magazine.

THE picture of the greatest poet of ancient Rome here presented to readers of *Discovery* is based on a mosaic discovered in a Roman villa in the year 1896, which (so far as I know) has never been reproduced in any English book or periodical. On the coast of Africa, north of Tunis, in the early centuries of the Empire, there were several towns or watering-places in which wealthy Romans loved to build mansions, because of the attractions of the climate and the scenery. In one of these called Hadrumetum, the modern Sousse, during the construction of the Arsenal by the French authorities, was uncovered the *tablinum*, or dining-room, of a handsome villa, which contained in the centre of its floor a mosaic about a metre square, with two smaller mosaics in adjoining rooms, an arrangement characteristic of the first two centuries (1)*. The largest is preserved in the Bardo Museum at Tunis and is here given from a water-colour painting made by M. Pradère, the director of that museum, who set himself to represent exactly the colour or colours of each separate cube in the mosaic (where some cubes are of marble, others of coloured glass), his work being reproduced by the French authorities just cited. It is remarkably accurate, as I can testify from my recollection of a visit to the museum in 1930. Since then I have made repeated attempts to secure a satisfactory reproduction, which have now succeeded through the kind help of a friend (2).



THE INSCRIPTION ON THE SCROLL.
Musa, mihi causas memora, quo numine laeso,
Quidve, . . .

Before considering the characteristics of the portrait, the reader will naturally ask what reasons we have for believing it an authentic likeness. This depends on the question of the date at which the mosaic was executed, and on the evidence we have of the existence of actual portraits of Vergil at that time. These questions, as Prof. Comparetti showed, have completely satisfactory answers.

One's first glance at the picture shows that it represents some reader of a book written in a scroll held in his left hand, and partly unrolled upon his knee; and the letters represented on the scroll show us what the book is, for they contain something over a line from the beginning of the *Aeneid*, namely, the eighth and the beginning of the ninth; and the two figures standing on either side of the reader can be identified at once as Clio, the Muse of History, on the left of the picture, and Melpomene, the Muse of Tragedy, with a tragic mask in her hand, on the right, both looking earnestly at the seated person. It is obvious that they would take no such interest in any one but the poet whom they were inspiring; and that the author of the mosaic thought of Vergil, as many of his ancient critics did, as a poet who combined history with tragedy. There can be therefore no doubt that the seated figure was meant to represent Vergil.

What means, then, have we of knowing whether the artist's attempt was based upon evidence accessible to him of what the poet's appearance really was? That depends on the date at which he made his attempt. For the sake of contrast Prof. Comparetti appended to his article a photograph of a would-be portrait of Vergil which appears in the *Codex Romanus* of his work, probably dating from the sixth century A.D., which is a merely imaginary picture of a studious but rather stupid youth, in which it would be hard to discover any characteristics worth noting, except certain marks which clearly indicate that the author of it belonged to the Early Middle (or Dark) Age, *i.e.*, to some century later than the Fifth, and was quite ignorant of how a Roman of the Augustan period

* Numbers in brackets throughout this article refer to notes which will be found on page 146.

was dressed. But for the date of our mosaic we have two quite different kinds of evidence, and taken together they indicate the end of the first or the early years of the second century A.D., that is, a date some time between the accession of the Emperor Nerva and the death of Hadrian at the latest.

Evidence of the Date.

The style and technique of the mosaic itself were dated with confidence by Prof. P. Gauckler not later than the early second century, and the painting on which no doubt it was based must have been earlier; and the perhaps more measurable, if less attractive, evidence of the letters on the scroll point to the same date.

Musa, mihi causas memora, quo numine laeso,
Quidve dolens, . . . *

The broad angles in the forms of the letters *m* and *n*; the absence of the cross-bar in the letter *a*; the loose shape of the letter *e* (the third symbol of the fourth line and the fifth of the second line); the long tail and angular shape of the *q* (at the beginning of the third line, and the fifth visible sign in the fourth); and the shape of the *s*, with its lowest stroke still solid and often almost horizontal, and of *l*; all point to the same date. The letters *e*, *m*, *n* and *s*, in particular, resemble those of a papyrus (3) found at Herculaneum containing a poem on the battle of Actium, which must, of course, have been written before Herculaneum was overwhelmed by the eruption of Vesuvius in A.D. 79.

Have we reason for thinking that authentic portraits of Vergil were in existence at this period? Martial, who wrote epigrams under Domitian (A.D. 81-96), in his Fourteenth Book, published about 85, tells us, in describing what we should call a Christmas gift of Vergil's poems (destined to be presented at the Saturnalia when it was the rule to send gifts to your friends), that the first page contained a portrait of Vergil himself. It is clear, therefore, that such portraits were commonly sold with editions of the poet's work; and we know that in the time of the elder Pliny (who died in the eruption of Vesuvius in A.D. 79 nearly 100 years after Vergil's death) all the libraries had statues of famous authors, a custom introduced by Asinius Pollio, the friend and protector of Vergil. So much was this the case that the mad Emperor Caligula proposed to destroy (4) all these statues, and with them the writings of the authors themselves, because he considered them rivals to his own fame, Vergil and Livy being especially mentioned as objects of his attack (5). It is implied, however, by the same authority, that his wild design was happily put aside. About a century later than the date of our mosaic we know that the Emperor Alexander Severus (A.D. 222-235) kept an image of Vergil beside those of his household gods, so that these records of the poet must have been continual at least down to his time.

Having thus good reason for believing that the picture before us is likely to be drawn from sources handed down by direct tradition in marble and bronze, and also in colour in the frontispiece to the best editions of the poet's work, we ask next why the artist should have chosen the eighth and not the first line of the *Aeneid*. The answer is suggested by the presence of the Muse of Tragedy. For in the *Aeneid*, although many of the Books contain stories of tragic intensity and are planned on the lines of Greek tragedy, there is only one that every reader would at once remember as being in the fullest sense a tragedy complete in itself, namely, the Fourth, which contains the moving story of the love of Dido and Aeneas, of their enforced separation for political reasons, and of her suicide from despair. And, of course, it is this Book, which, in ancient times as well as in modern, has exercised the greatest fascination upon every reader of the poem. The figure of Dido is indeed, as an almost unwilling witness declares, " the most perfect embodiment of disinterested love—nay, of love in opposition to interest—for which a grateful world has to thank a poet " (6).

The Muse of Tragedy.

That the artist was thinking of Dido is confirmed by the subject of the smaller mosaic which occupied an adjoining room, the parting of Aeneas from Dido; and since the villa which these mosaics adorned was within a few miles of the site of Carthage, it is easy to understand that its owner, having very likely (7) some personal interest in Carthage and its history, should choose the Carthaginian part of Aeneas' story for the artist's subject. Therefore, in selecting a line from the *Aeneid* to be put into his picture, the artist chose not the first lines of the poem, which mention only Troy and Rome, but the line which begins the story of Juno's anger; for it was Juno who raised the storm which cast Aeneas upon the African coast, and Juno who, in a complot with Venus, contrived that Aeneas and Dido should be thrown together, and who finally raised another storm which led to their fate-fraught isolation in a cave of the forest. Hence we see how appropriate it is that the Muse of

* ' O Muse, tell me the reasons, for what violation of her divine purposes, or for what grievous offence . . . (did the Queen of Heaven persecute the innocent Aeneas ?) '

THE PORTRAIT OF VERGIL

From the water-colour painting by Bertrand Pradère

Tragedy should be gazing upon the poet somewhat more fully and intently than the Muse of History, whose attitude is rather that of one who has been interrupted in reading from her scroll by the more poignant utterances of her tragic sister.

But it is time to come to Vergil himself. What does the portrait teach us of him? Of the suggestions, vivid, pathetic and profound, of his face and look, I may quote the words of Dr. J. W. Mackail from the Introduction to his edition of the *Aeneid* which is mentioned below (2): "The face is thin and worn, the complexion sallow; the delicate features bear traces of habitually poor health. The hair is dark brown, showing flecks of grey; the forehead finely moulded; the mouth sensitively delicate; the eyes large, deeply set, and luminous."

But there are other points hardly less interesting in the picture. Even in the face itself the parted lips and the bright eyes give us a clear suggestion of humour as well as of deep feeling; and the thin fingers of the right hand, the slender arm, the sunken cheeks, spare features, prominent chin, and tightly drawn fold of the skin of the neck, all suggest the frailty of the poet's bodily strength, always subject to dyspepsia with sudden flushes and occasional haemorrhage, and brought to its end before he was fifty-one. And the head held upright, the look of eagerness, and the position of the forefinger seem to represent, as Comparetti has happily seen, the mien and gesture of one who has conceived some new thought and is considering it with mingled pleasure and criticism before writing it down. And that is why the words quoted from the poem break off in the middle of the line. The poet is pictured in the very act of composing his tragic romance from the beginning.

Details of the Figure.

The personal details of the figure are not without significance. Though seated, it is that of a man of tall stature. The dark complexion, and the naive expression of a man reared in the country and always averse from the life of great cities ("with a rustic appearance," *facies rusticana*), as Donatus says, whose figure and dress might be counted ungainly (*indecori et corporis et habitus fuit*), are all characteristics recorded by ancient biographers. And there is a well-known passage of Horace remonstrating with superficial judges for ridiculing an author whose hair is cut in country fashion, whose toga hangs down too low, and whose shoes fit only loosely to his feet.

These characteristics are definitely represented in this picture. The hair has what we should call a "prison-crop"; the toga, where it is thrown back over the left shoulder, instead of being brought down again (over its fastening on the left breast) so as to form a kind of pocket or fold just above the waist, goes straight across to the top of his shoulder from the right elbow and consequently falls streaming down behind till it almost touches the floor, and has to be picked up again in something of a hunch and laid across his knee; and without going into details about the shoes, it is obvious at a glance that the broad, turned up toes are meant to represent something rather unshapely.

"A Real Good Fellow."

But what more does Horace say about the ill-clad person? "But he is a real good fellow; no nobler man ever lived. Yes, and a friend of yours. Yes, and there is a great genius hidden beneath that neglected appearance." Some commentators have supposed that Horace is describing himself; but on the one hand there is no reason to suppose that the dainty, dapper Horace (*totus, teres atque rotundus*) would ever have "neglected" his attire, or ever wore ill-fitting shoes or let his toga hang down too long. One would rather expect that Horace's toga, in his early days of poverty, would be too small, shrunk by frequent washing, as one of his commentators suggests. And on the other hand, if Horace's friends had ever suspected that he was attributing the "noble" character and "great genius" to himself, they would not merely have chaffed him unmercifully, but told him that this was the only time he had ever made such a boast. Too much stress must not be laid on the statement of the ancient commentator Acron that in this passage Horace is describing his friend Vergil, because, after all, Horace's picture is unnamed, and he might well add or omit any one point as might serve his picturesque purpose at the moment. But there does seem a considerable likeness between the passage and the details of this mosaic, which lead us to regard Acron's statement as having gained a good deal in probability from its evidence.

In any case there can be no doubt whatever that we have here a portrait of Vergil on which a mosaic artist, in a fine period of that art, has lavished thought and feeling and exquisite skill; and that he had before him a great number of portraits and statues of the poet which had come down from the poet's lifetime and from which he could frame his own conception, in fact would be bound to do so if he was to satisfy his patron. And the portrait itself shows a glow of enthusiasm for his subject and a stern faithfulness in details, whether pleasing or not, that would lead us to accept them as true, even if they were not

confirmed by our written records of what Vergil was like.

We may therefore not merely treasure the picture as a work of art of rare and profound beauty, but study it as an authentic presentment, in which (with Comparetti) we may trace "the goodness of heart, the gentleness, modesty and shy reserve, and not less the noble and penetrating intellectual power" of one whom Bacon justly named "the chastest poet and the royalest that to the memory of man is known."

NOTES.

(The numbers of the references will be found in the text of the article.)

(1) Gauckler, *Mon. et Mém. de l'Acad. Inscrr.*, Fond Eugène Piot, iv (1898), p. 234.

(2) A copy of an article by the late Prof. Domenico Comparetti in the Florentine Journal *Atene e Roma*, in 1914, has been generously placed at my service by Mr. J. A. Spranger of Florence; but our photograph is taken from the reproduction (in the volume of *Mon. et Mém.* just cited) made by the French archaeologist M. P. Gauckler, whence Comparetti's was derived, as he states in the article.

A recent edition of the *Aeneid* by Mr. J. W. Mackail (Oxford, 1931) contains a clever sketch of the poet's head, drawn from the mosaic. But the whole picture, as we shall see, contains many other points of interest, which throw light on the central figure. I have good hope that the whole will be reproduced in colours in the edition of the *Aeneid* now being prepared (for Messrs. G. Bell & Sons, to take the place of Conington's) by myself in conjunction with Mr. F. H. Sandbach and Mrs. Kathleen Atkinson.

(3) Fr. Steffens, *Lat. Palaeogr.*, 1903, Tab. 4; Maunde Thompson, *Gr. and Lat. Palaeogr.*, 1912, p. 276. The forms of the letters in the mosaic resemble more closely those in the upper (older) half of Maunde Thompson's Tab. 101 (p. 312) from graffite of Pompeii before A.D. 79, than they do those of his Tab. 104 (p. 317) which are from wax tablets about fifty years later.

(4) Pliny, *Nat. Hist.*, xxxv, § 10.

(5) Suetonius, *Calig.*, 34.

(6) James Henry, *Aeneidea*, Vol. I, p. 635.

(7) This likelihood is very strong from other evidence of the great popularity of Vergil in Africa. We know of no less than five minor Latin poets who came from North Africa and who closely imitated Vergil; and among the admirers of Vergil whom Macrobius (in the IV Cent. A.D.) represents as taking part in his discussions of Vergil's work, several come from North Africa, and three (of the family of the Albini) from this very place, Hadrumetum.

Fresh Uses for Flax.

NEW and important commercial possibilities for phormium tenax, or New Zealand flax, are being explored by two Dominion research workers who have set up a laboratory and plant at Auckland, New Zealand, for the industrial application of the results of their investigations. The use of the fibre of New Zealand flax, which is really a member of the lily family, has hitherto been confined almost solely to the production of hemp and similar textiles, and the work of Dr. A. J. Brown and his assistant promises to raise this product to a leading position among the Dominion's commodities.

Animals Like Rowing Boats.

IN every stretch of water, whether salt or fresh, there occur a number of minute animals known as copepods. Their name is derived from the oarlike action of their swimming feet. Although these animals were named nearly a hundred years ago, it is only quite recently that the precise action of their feet has been understood. In an interesting letter to the *Times*, Mr. Ashley G. Lowndes of Marlborough College states that copepods have recently been subjected to a photographic examination known as the polygraphic process by which they are filmed during swimming. "Each animal," writes Mr. Lowndes, "is a most wonderful little 'eight,' since it possesses four pairs of swimming feet, so that in this eight one must imagine the rowers sitting side by side. The analogy is, however, incorrect, since each swimming-foot consists of two rami, so the animal is really a 'sixteen.'"

The particular animal described is a species of Diaptomus, so-called on account of its remarkable powers of flying through the water. It can be shown that the animal is capable of darting through the water at a rate of a foot a second, though it actually makes leaps of about two inches only, but since the animal is only one-tenth of an inch long, it means that it darts through the water by covering a distance of twenty times its own length at a single bound.

The action is complicated, writes Mr. Lowndes, and one must not try to stress the analogy of the rowing boat, but briefly it is as follows: All sixteen rami are pointed well forward, and by the action of powerful body muscles the animal leaps on its own feet, the tips of which move through a very small angle. They are never brought back, so that one can imagine that the oars never pass behind the rigger. The stroke therefore consists of a prodigious leap carefully synchronized on all the sixteen oars.

There are a great many other kinds of copepods all possessing about the same number of feet; these work in several different ways, but in no case can the speed be compared with that attained by Diaptomus or other closely allied genera.

"During these swimming movements the body of the animal undergoes a considerable change in shape. According to various articles on rowing the three epoch-making changes have been: the invention of the out-rigger; the invention of the sliding seat; and the invention of the funny or smooth-built boat instead of the clinker. It would indeed be interesting if the next step should prove to be the invention of some sort of flexible boat."

Wings Over Everest.

By Colonel the Master of Sempill, A.F.C., F.R.Ae.S.

On April 5th two British aeroplanes crossed the summit of Mount Everest. The flight will remain as a magnificent achievement in the history of aviation no less than in that of mountaineering. The Master of Sempill contrasts the almost effortless ease with which Everest has at last been conquered with the laborious struggles of the early "Pundit climbers."

PICTURE for a moment the uninspiring offices of Sir Andrew Waugh, Surveyor-General to the Indian Government, on a hot and stifling Indian day in 1852. Sir Andrew, Scots and imperturbable, was seated at his desk. Suddenly the door was flung open, and a native, the Bengali Chief Computer, dashed into the room. "Sir," he gasped. "I have discovered the highest mountain in the world." Sir Andrew's eyebrows, we may infer, climbed a shade higher. He probably put it down to the sun. But the Bengali was right. For months past the Trigonometrical Survey had been engaged on laborious observations of the Nepales peaks from the Indian frontier. They had grouped them, classified them, named them where possible and accumulated a monumental pile of data. Most of the peaks had native names. These they still bear. But some were nameless, even to the natives. Such peaks were known by numbers. One, first observed in 1849, was known as "Peak XV." It was among the highest noticed, but to the naked eye, broke no obvious records.

THE AEROPLANE.

The Houston-Westland machine in which the historic flight over Everest was made. It is fitted with a Bristol Pegasus engine.

But poring over the mass of observations and data collected during the past three or four years, the Bengali arrived at the conclusion that the mountain was no less than 29,000 and two feet high. His conclusions were checked and re-checked. The peak had been seen from six stations, and from the six sets of observation the mean height was computed. Years after it was re-checked and increased to 31,145 feet. Sir George Everest had acted as Sir Andrew Waugh's predecessor, and under him the triangulations had been commenced, so Sir Andrew named the mountain Mount Everest. The Tibetan name is Chomolungma, "The Goddess Mother of the World."

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Since then the lure of Everest has been irresistable. Invincible in the heart of that 3,000 mile range of gigantic mountains, a hundred peaks of which are more than 24,000 feet in height, while six are more than 27,000 feet, Everest, five and a half miles high, has beckoned and defied, slain and remained inviolate. Expedition after expedition has started from the burning plains, traversed the jungle, climbed the foothills, breasted the snowfield slopes — and retired, defeated. Thirteen lives have been lost, and still the foot of man has not trod that virgin summit.

For years past airmen have dreamed dreams and made plans, to conquer this last defiance of earth. Frenchmen, Italians, Germans, Americans and Englishmen have all made their plans, built their hopes. There is no copyright in the idea of flying over Mount Everest, no claim to originality in the genesis of the flight which has just been successful. Sir Alan Cobham attempted to fly over the mountain eighteen years ago. He followed the airways of those lost ranges, white spaces in the air knowledge of the world, even as the ranges themselves are white spaces on the map, marked rarely by the dotted lines where the half-forgotten paths of Abbé Huc, Turner, Manning and Bogle, waver toward the goal they never reached.

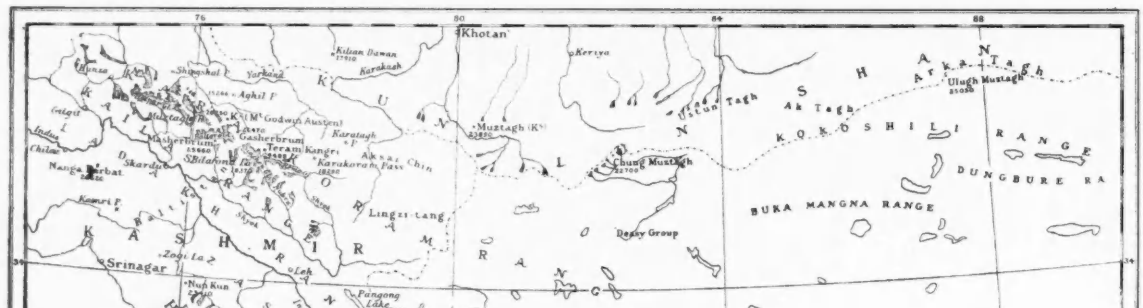
Since then many explorers, British, Indian and Russian, have attempted to scale "the doomed mountain," as Sir Francis Younghusband described it after the last glorious failure. But of them all, although the tale of their deeds is an heroic saga, bright with the flame of courage, I like best to look back down the musty corridor of seventy years of Indian Government history, to those now forgotten "Pundit Explorers."

The story of these men is probably the most interesting in the whole history of Everest exploration.

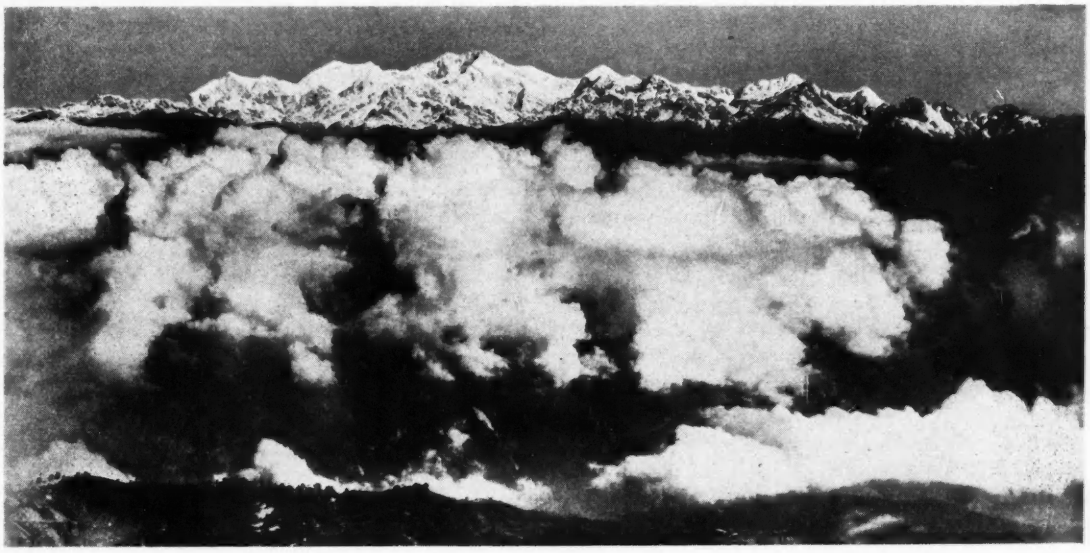
They were the creation of Captain Montgomery of the Indian Survey who, in 1860, conceived the idea of training certain intelligent Indians to act as what one may describe as " secret service surveyors." One, for example, was the gallant Mirza Shuja, a Persian, who penetrated Northern Afghanistan and traversed the Pamirs. Years later he was murdered in his sleep at Bokhara, some thought by order of the Emir of Afghanistan. Then there was Ata Mahomed, " The Mullah " who laid bare the secrets of the then unknown gorge of the Indus.

So secret was their work that these men were not even allowed to be known by their names. They were referred to simply by their initials. They travelled disguised, were sometimes away for months and even years on end, were trained surveyors and earned only a few rupees a month—paid when they returned! Every step they took was counted by the revolutions of their prayer wheels or by telling the beads on their rosaries. When night fell, their notes were written down in secret. Even their little compasses were concealed in amulets round their necks, while their thermometers were hidden in hollow walking sticks. Although these men and the work they did was pigeon-holed seventy years ago, their computations, checked to-day by wireless telegraphy, have in nearly every case been found to be almost exact.

Another, the Pundit Kintup, was sent to trace the source of the mighty Tsanpo, the great river of Tibet. It was arranged beforehand that each day and night he should cast special blocks of wood into the river, recording his progress. These were to be picked up on the frontier by a survey patrol under Captain Harman. For two years Harman watched the swirling waters of the mighty river. Never a block came down from the forbidden land of the Lamas. Then Harman fell ill. He was sent home. The watch was given up, so also was all hope of Kintup.



MAP OF THE HIMALAYA, SHOWING MT. EVEREST, KANGCHENJUNGA AND OTHER IMPORTANT PEAKS.



THE 'DOOMED MOUNTAIN."
A magnificent view of the Mt. Everest range, with monsoon clouds in the foreground, seen from the Mall, Darjiling. (E.N.A. photo.)

More than four years later, Kintup returned to India with an almost complete account of the course of the river. He had been captured in Tibet and sold as a slave. Four years of bondage followed and then he escaped. But instead of returning direct to India he set himself to accomplish the mission on which he had begun. Each day he cut his blocks of wood, threw them into the river and went on. But there was no watcher to retrieve the precious blocks. When eventually he returned, many disbelieved his story. The Survey Department believed him. The Indian Government gave him the C.I.E. and made him Malik of a prosperous village. Subsequent surveys proved his observations and reports to be completely true.

Another Pundit, Hari Ram, known as "M.H.", attempted to reach Everest. He actually crossed a pass 20,000 feet high, west of the mountain, and got to Dingri on its north side in Tibet. He, indeed, and Sarat Chandra Das, who explored on his own in 1879, were the first foreigners from outside Tibet to approach really close to the mountain.

What a difference between those early, simple travellers on foot, disguised as traders, pilgrims and merchants who took their lives in their hands and fared forth on their feet into the unknown of the snows, and the superbly equipped, ultra-modern expedition of Lady Houston which so recently left this country and with almost effortless ease, conquered Everest, the inviolate.

The genesis of the expedition is interesting. Like many others before them, Colonel P. T. Etherton and Lieut.-Col. L. V. S. Blacker, two retired officers, decided that it would be a good thing to fly over Everest. They had no money and little organization. The whole thing was nebulous in the extreme. Etherton was not even a pilot and Blacker had not flown for many years. But they worked hard for months on what data they were able to gather. Then that energetic pilot and M.P., Lord Clydesdale, heard of their ambition. He sought them out. They confessed their lack of funds. He placed the matter before Lady Houston. She, with that ready munificence and direct vision which has made her probably the greatest individual patriot of this century, realized that here once more was a chance to place Britain in the forefront of world aviation, as she had done a short time before when she enabled this country, by her magnificent gift of £100,000, to win the Schneider Trophy outright.

Lady Houston did more than merely put up the funds. Ill though she was, her far-sighted, shrewd and resolute brain took command. She saw that the organization was placed on a proper business and technical footing. A Committee was formed. Air Commodore P. F. M. Fellowes, an officer recently retired from the R.A.F., was placed in supreme command. Mr. R. D. Blumenfeld and Mr. J. Wentworth Day entered the organization as Lady Houston's personal representatives and negotiated many of the business contracts. Within a few days of Lady Houston's

entry into the field, orders were given for the aeroplanes, engines and equipment. The Westland Works at Yeovil, the Bristol Aeroplane Company Works at Bristol, the Research Department of Messrs. Williamson, the aerial camera manufacturers, and of Messrs. Siebe Gorman and Company, the life-saving experts, were hard at work. The Shell Mex organization put its best brains to the task of providing suitable fuel. The British Oxygen Company took up the question of providing oxygen which could be guaranteed to remain dry throughout the overseas shipment and the flight to the summit.

Offices were placed at the disposal of the Expedition by the proprietors of Grosvenor House. They became a hive of activity. Within a few months the last detail was completed, the machines, equipment and personnel left for India and, after a few trial flights, on April 3rd the mountain was conquered.

On the morning of the 3rd Mr. S. N. Gupta, the Indian Meteorological Officer at Purnea, the base of the Expedition in Bihar, reported from balloon observations that the wind, which till then had been unsuitable, had dropped to a velocity of 57 m.p.h. at 33,000 feet, the altitude which it had been decided would be the most suitable working height for photographic survey. The two machines took off at 8.25 a.m. from Lalbalu aerodrome, the Houston Westland piloted by Lord Clydesdale and the Westland Wallace crewed by Flight-Lieut. D. F. McIntyre and Mr. S. R. Bonnett, aerial photographer to the Gaumont British Film Corporation. The straight route to the summit meant flying on a track of 342 degrees. The compass course had to be changed at intervals in a westerly direction because of the increase of wind velocity with height.

Over the Summit.

The machines climbed slowly at low engine revolutions to a height of 10,000 feet, during which a heavy dust haze almost completely obscured the ranges. During this climb both crews tested their electrically heated suits and oxygen breathing apparatus which had been specially built by Messrs. Siebe Gorman and Company. After thirty minutes' flying, at a height of 19,000 feet, forty miles forward from the base, Everest became visible above the haze. It was impossible to identify any landmarks until within twenty miles of the summit. At 9 o'clock the machines passed over Chamlang at a height of 31,000 feet.

Approaching Lhotse, the southern peak of the Everest group, both machines lost 1,500 feet of altitude owing to a steady down current caused by deflection of the west wind over the mountain. At 10.5 both aeroplanes flew over the summit of Everest in a high wind, clearing it by some hundreds of feet only, nearly 4,000 feet less than the height at which they had planned to reach it.

It had been expected that it would be impossible to fly over the summit at anything like this height, owing to the terrific turbulence which was expected. It must be remembered that previous observers, including General Bruce himself, had repeatedly stated that the up-drafts over the summit appeared to be so strong that driven snow, the famous "White Plume of Everest," was whirled up three and four thousand feet into the air. A quarter of an hour was spent in flying round the summit during which extensive survey photographs were taken. These are eagerly awaited.

Titanic Splendour.

Generally speaking, the flight can be described as an unqualified success. It must remain for ever as a supreme tribute to the superb workmanship of the firms who contributed to the equipment and to the courage and skill of those who took part. The view from the summit was magnificent beyond conception. For hundreds of miles on either side the vast ranges of the Goddess Mother of the Earth stretched in titanic splendour. Peak upon peak rose in jagged waves. Between them yawned thunderous gorges, canyons bottomless as night. To have crashed or attempted to land would have been death. No possible human agency could have saved them. Less than two hours later the machines landed faultlessly at their base.

A few days afterwards both machines flew over Kangchenjunga, the third highest mountain in the world. This time the Houston-Westland was piloted by the leader of the flight, Air-Commodore Fellowes. On his return journey, Air-Commodore Fellowes unfortunately lost his way owing to bad visibility and was obliged to make a forced landing at Dinajpur, where he came down owing to petrol shortage. Neither he nor the machine was injured. On the following day, having taken fresh supplies of petrol, the machine flew back to the base.

Thus concluded in a few weeks what will stand for all time as one of the epic flights in the history of aviation, a flight which must remain throughout history as the last supreme achievement to be made by man in the conquest of the one spot on earth which had defied all the assaults that man could make against it. Immortal as this achievement must remain, no less immortal remains the name of Lady Houston who alone, though sick, made it possible.

Light and Life.

By Neils Bohr.

Professor of Physics, University of Copenhagen.

The problem of the nature of light has been subjected to renewed discussion as a result of recent discoveries in atomic physics. On this theme Professor Bohr bases the following article. He shows how the revision of the foundation of mechanics has created a new background for discussing the relation of physics to the problems of biology.

It is interesting to consider the significance of the results obtained by physical research in our views of living organisms in the realm of natural science. This problem has presented itself at every stage of science, since any scientific explanation necessarily must consist in reducing the description of more complex phenomena to that of simpler ones.

New Problems.

At the moment, however, the unsuspected discovery of an essential limitation of the mechanical description of natural phenomena, revealed by the recent development of the atomic theory, has lent new interest to the old problem. This limitation was, in fact, first recognized through a thorough study of the interaction between light and material bodies, which disclosed features that cannot be brought into conformity with the demands hitherto made to a physical explanation. As I shall endeavour to show, the efforts of physicists to master this situation resemble in some way the attitude which biologists more or less intuitively have taken towards the aspects of life. Still, I wish to stress at once that it is only in this formal respect that light, which is perhaps the least complex of all physical phenomena, exhibits an analogy to life, the diversity of which is far beyond the grasp of scientific analysis.

From a physical point of view, light may be defined as the transmission of energy between material bodies at a distance. As is well known, such an energy transfer finds a simple explanation in the electromagnetic theory, which may be regarded as a direct extension of classical mechanics compromising between action at a distance and contact forces. According to this theory, light is described as coupled electric and magnetic oscillations which differ from the ordinary electro-magnetic waves used in radio transmission only by their greater frequency of vibration and smaller wavelength. In fact the practically rectilinear propagation of light, on which rests our location of bodies by direct vision or by suitable optical instruments, depends entirely on the smallness of the wavelength compared with the dimensions of the bodies concerned, and of the instruments.

The idea of the wave nature of light, however, not only forms the basis for our explanation of the colour phenomena, which in spectroscopy have yielded such important information of the inner constitution of matter, but is also of essential importance for every detailed analysis of optical phenomena. As a typical example, I need only mention the interference patterns which appear when light from one source can travel to a screen along two different paths. In such a case, we find that the effects which would be produced by the separate light beams are strengthened at those points on the screen where the phases of the two wave trains coincide, that is, where the electric and magnetic oscillations in the two beams have the same directions, while the effects are weakened and may even disappear at points where these oscillations have opposite directions, and where the two wave trains are said to be out of phase with one another. These interference patterns have made possible such a thorough test of the wave nature of the propagation of light, that this conception can no longer be considered as a hypothesis in the usual sense of this word, but may rather be regarded as an indispensable element in the description of the phenomena observed.

A Dilemma.

As is well known, the problem of the nature of light has been subjected to renewed discussion in recent years, as a result of the discovery of a peculiar atomistic feature in the energy transmission which is quite unintelligible from the point of view of the electromagnetic theory. It has turned out, in fact, that all effects of light may be traced down to individual processes, in each of which a so-called light quantum is exchanged, the energy of which is equal to the product of the frequency of the electromagnetic oscillations and the universal quantum of action, or Planck's constant. The striking contrast between this atomicity of the light phenomena and the continuity of the energy transfer according to the electromagnetic theory places us before a dilemma of a character hitherto unknown in physics. For, in spite of the obvious insufficiency of the wave picture, there can be no question of replacing it by any other picture of light propagation depending on ordinary mechanical ideas.

Especially, it should be emphasized that the intro-

duction of the concept of light quanta in no way means a return to the old idea of material particles with well-defined paths as the carriers of the light energy. In fact, it is characteristic of all the phenomena of light, in the description of which the wave picture plays an essential role, that any attempt to trace the paths of the individual light quanta would disturb the very phenomenon under investigation ; just as an interference pattern would completely disappear, if, in order to make sure that the light energy travelled only along one of the two paths between the source and the screen, we should introduce a non-transparent body into one of the paths. The spatial continuity of light propagation on the one hand and the atomicity of the light effects on the other hand must, therefore, be considered as complementary aspects of one reality, in the sense that each expresses an important feature of the phenomena of light, which, although irreconcilable from a mechanical point of view, can never be in direct contradiction, since a closer analysis of one or the other feature in mechanical terms would demand mutually exclusive experimental arrangements.

At the same time, this very situation forces us to renounce a complete causal description of the phenomena of light and to be content with probability calculations, based on the fact that the electromagnetic description of energy transfer by light remains valid in a statistical sense. Such calculations form a typical application of the so-called correspondence argument, which expresses our endeavour, by means of a suitably limited use of mechanical and electromagnetic concepts, to obtain a statistical description of the atomic phenomena that appears as a rational generalization of the classical physical theories, in spite of the fact that the quantum of action from their point of view must be considered as an irrationality.

A Wider View.

At first sight, this situation might appear deplorable ; but, as has often happened in the history of science, when new discoveries have revealed an essential limitation of ideas the universal applicability of which had never been disputed, we have been rewarded by getting a wider view and a greater power of correlating phenomena which before might have appeared as contradictory. Thus, the strange limitation of classical mechanics, symbolized by the quantum of action, has given us a clue to an understanding of the peculiar stability of atoms which forms a basic assumption in the mechanical description of any natural phenomenon. The recognition that the indivisibility of atoms cannot be understood in mechanical terms has always characterized the atomic theory, to be sure ; and this fact is not essentially altered, although the development of physics has replaced the indivisible atoms by the elementary electric particles, electrons and atomic nuclei, of which the atoms of the elements as well as the molecules of the chemical compounds are now supposed to consist.

Classical Theories.

However, it is not to the question of the intrinsic stability of these elementary particles that I am here referring, but to the problem of the required stability of the structures composed of them. As a matter of fact, the very possibility of a continuous transfer of energy, which marks both the classical mechanics and the electromagnetic theory, cannot be reconciled with an explanation of the characteristic properties of the elements and the compounds. Indeed, the classical theories do not even allow us to explain the existence of rigid bodies, on which all measurements made for the purpose of ordering phenomena in space and time ultimately rest. But, in connexion with the discovery of the quantum of action, we have learned that every change in the energy of an atom or a molecule must be considered as an individual process, in which the atom goes over from one of its so-called stationary states to another. Moreover, since just one light quantum appears or disappears in a transition process by which light is emitted or absorbed by an atom, we are able by means of spectroscopic observations to measure directly the energy of each of these stationary states. The information thus derived has been most instructively corroborated also by the study of the energy exchanges which take place in atomic collisions and in chemical reactions.

In recent years, a remarkable development of the atomic theory has taken place ; this has given us such adequate methods of computing the energy values for the stationary states, and also the probabilities of the transition processes, that our account, on the lines of the correspondence argument, of the properties of atoms as regards completeness and self-consistency scarcely falls short of the explanation of astronomical observations offered by Newtonian mechanics. Although the rational treatment of the problems of atomic mechanics was possible only after the introduction of new symbolic artifices, the lesson taught us by the analysis of the phenomena of light is still of decisive importance for our estimation of this development. Thus, an unambiguous use of the concept of a stationary state is complementary to a mechanical analysis of intra-atomic motions ; in a similar way the idea of light quanta is complementary

to the electromagnetic theory of radiation. Indeed, any attempt to trace the detailed course of the transition process would involve an uncontrollable exchange of energy between the atom and the measuring instruments, which would completely disturb the very energy transfer we set out to investigate.

A causal description in the classical sense is possible only in such cases where the action involved is large compared with the quantum of action, and where, therefore, a subdivision of the phenomena is possible without disturbing them essentially. If this condition is not fulfilled, we cannot disregard the interaction between the measuring instruments and the object under investigation, and we must especially take into consideration that the various measurements required for a complete mechanical description may only be made with mutually exclusive experimental arrangements. In order fully to understand this fundamental limitation of the mechanical analysis of atomic phenomena, one must realize clearly, further, that in a physical measurement it is never possible to take the interaction between object and measuring instruments directly into account. For the instruments cannot be included in the investigation while they are serving as means of observation. As the concept of general relativity expresses the essential dependence of physical phenomena on the frame of reference used for their co-ordination in space and time, so does the notion of complementarity serve to symbolize the fundamental limitation, met with in atomic physics, of our ingrained idea of phenomena as existing independently of the means by which they are observed.

Physics and Biology.

This revision of the foundations of mechanics, extending to the very question of what may be meant by a physical explanation, has not only been essential, however, for the elucidation of the situation in atomic theory, but has also created a new background for the discussion of the relation of physics to the problems of biology. This must certainly not be taken to mean that in actual atomic phenomena we meet with features which show a closer resemblance to the properties of living organisms than do ordinary physical effects. At first sight, the essentially statistical character of atomic mechanics might even seem difficult to reconcile with an explanation of the marvellously refined organization which every living being possesses, and which permits it to implant all the characteristics of its species into a minute germ cell.

We must not forget, however, that the regularities peculiar to atomic processes, which are foreign to causal mechanics and find their place only within the complementary mode of description, are at least as important for the account of the behaviour of living organisms as for the explanation of the specific properties of inorganic matter. Thus, in the carbon assimilation of plants, on which depends largely also the nourishment of animals, we are dealing with a phenomenon for the understanding of which the individuality of photo-chemical processes must undoubtedly be taken into consideration. Likewise the peculiar stability of atomic structures is clearly exhibited in the characteristic properties of such highly complicated chemical compounds as chlorophyll or haemoglobin, which play fundamental roles in plant assimilation and animal respiration

Living Beings.

But analogies from chemical experience will not, of course, any more than the ancient comparison of life with fire, give a better explanation of living organisms than will the resemblance, often mentioned, between living organisms and such purely mechanical contrivances as clockworks. An understanding of the essential characteristics of living beings must be sought, no doubt, in their peculiar organization, in which features that may be analysed by the usual mechanics are interwoven with typically atomistic traits in a manner having no counterpart in inorganic matter.

An instructive illustration of the refinement to which this organization is developed has been obtained through the study of the construction and function of the eye, for which the simplicity of the phenomena of light has again been most helpful. I need not go into details here, but shall just recall how opthalmology has revealed to us the ideal properties of the human eye as an optical instrument. Indeed, the dimensions of the interference patterns, which on account of the wave nature of light set the limit for the image formation in the eye, practically coincide with the size of such partitions of the retina which have separate nervous connexion with the brain. Moreover, since the absorption of a few light quanta, or perhaps of only a single quantum, on such a retinal partition is sufficient to produce a sight impression, the sensitiveness of the eye may even be said to have reached the limit imposed by the atomic character of the light effects. In both respects, the efficiency of the eye is the same as that of a good telescope or microscope, connected with a suitable amplifier so as to make the individual processes observable. It is true that it is possible by such instruments essentially to increase our powers of observation, but, owing to the very limits imposed by the properties of light, no instrument is

imaginable which is more efficient for its purpose than the eye. Now, this ideal refinement of the eye, fully recognized only through the recent development of physics, suggests that other organs also, whether they serve for the reception of information from the surroundings or for the reaction to sense impressions, will exhibit a similar adaptation to their purpose, and that also in these cases the feature of individuality symbolized by the quantum of action, together with some amplifying mechanism, is of decisive importance. That it has not yet been possible to trace the limit in organs other than the eye depends solely upon the simplicity of light as compared with other physical phenomena.

The recognition of the essential importance of fundamentally atomistic features in the functions of living organisms is by no means sufficient, however, for a comprehensive explanation of biological phenomena. The question at issue, therefore, is whether some fundamental traits are still missing in the analysis of natural phenomena, before we can reach an understanding of life on the basis of physical experience. Quite apart from the practically inexhaustible abundance of biological phenomena, an answer to this question can scarcely be given without an examination of what we may understand by a physical explanation, still more penetrating than that to which the discovery of the quantum of action has already forced us. On one hand, the wonderful features which are constantly revealed in physiological investigations and differ so strikingly from what is known of inorganic matter, have led many biologists to doubt that a real understanding of the nature of life is possible on a purely physical basis. On the other hand, this view, often known as vitalism, scarcely finds its proper expression in the old supposition that a peculiar vital force, quite unknown to physics, governs all organic life. I think we all agree with Newton that the real basis of science is the conviction that nature under the same conditions will always exhibit the same regularities. Therefore, if we were able to push the analysis of the mechanism of living organisms as far as that of atomic phenomena, we should scarcely expect to find any features differing from the properties of inorganic matter.

Uncertainties.

With this dilemma before us, we must keep in mind, however, that the conditions holding for biological and physical researches are not directly comparable since the necessity of keeping the object of investigation alive imposes a restriction on the former, which finds no counterpart in the latter. Thus, we should doubtless kill an animal if we tried to carry the investigation of its organs so far that we could describe the role played by single atoms in vital functions. In every experiment on living organisms, there must remain an uncertainty as regards the physical conditions to which they are subjected, and the idea suggests itself that the minimal freedom we must allow the organism in this respect is just large enough to permit it, so to say, to hide its ultimate secrets from us. On this view, the existence of life must be considered as an elementary fact that cannot be explained, but must be taken as a starting point in biology, in a similar way as the quantum of action, which appears as an irrational element from the point of view of classical mechanical physics, taken together with the existence of the elementary particles, forms the foundation of atomic physics. The asserted impossibility of a physical or chemical explanation of the function peculiar to life would in this sense be analogous to the insufficiency of the mechanical analysis for the understanding of the stability of atoms.

Different Aspects.

In tracing this analogy further, however, we must not forget that the problems present essentially different aspects in physics and in biology. While in atomic physics we are primarily interested in the properties of matter in its simplest forms, the complexity of the material systems with which we are concerned in biology is of fundamental significance since even the most primitive organisms contain a large number of atoms. It is true that the wide field of application of classical mechanics, including our account of the measuring instruments used in atomic physics, depends on the possibility of disregarding largely the complementarity entailed by the quantum of action, in the description of bodies containing very many atoms. It is typical of biological researches, however, that the external conditions to which any separate atom is subjected can never be controlled in the same manner as in the fundamental experiments of atomic physics. In fact, we cannot even tell which atoms really belong to a living organism, since any vital function is accompanied by an exchange of material, whereby atoms are constantly taken up into and expelled from the organization which constitutes the living being.

This fundamental difference between physical and biological investigations implies that no well-defined limit can be drawn for the applicability of physical ideas to the phenomena of life, which would correspond to the distinction between the field of causal mechanical

description and the proper quantum phenomena in atomic mechanics. However, the limitation which this fact would seem to impose upon the analogy considered will depend essentially upon how we choose to use such words as physics and mechanics. On one hand, the question of the limitation of physics within biology would, of course, lose any meaning, if, in accordance with the original meaning of the word physics, we should understand by it any description of natural phenomena. On the other hand, such a term as atomic mechanics would be misleading, if, as in common language, we should apply the word mechanics only to denote an unambiguous causal description of the phenomena.

The Concept of Purpose.

I shall not here enter further into these purely logical points, but will only add that the essence of the analogy considered is the typical relation of complementarity existing between the sub-division required by a physical analysis and such characteristic biological phenomena as the self-preservation and the propagation of individuals. It is due to this situation, in fact, that the concept of purpose, which is foreign to mechanical analysis, finds a certain field of application in problems where regard must be taken of the nature of life. In this respect, the role which teleological arguments play in biology reminds one of the endeavours, formulated in the correspondence argument, to take the quantum of action into account in a rational manner in atomic physics.

In our discussion of the applicability of mechanical concepts in describing living organisms, we have considered these just as other material objects. I need scarcely emphasize, however, that this attitude, which is characteristic of physiological research, involves no disregard whatsoever of the psychological aspects of life. The recognition of the limitation of mechanical ideas in atomic physics would much rather seem suited to conciliate the apparently contrasting points of view which mark physiology and psychology. Indeed, the necessity of considering the interaction between the measuring instruments and the object under investigation in atomic mechanics corresponds closely to the peculiar difficulties, met with in psychological analyses, which arise from the fact that the mental content is invariably altered when the attention is concentrated on any single feature of it.

It will carry us too far from our subject to enlarge upon this analogy which, when due regard is taken to the special character of biological problems, offers a new starting point for an elucidation of the so-called psycho-physical parallelism. However, in this connexion, I should like to emphasize that the considerations referred to here differ entirely from all attempts at viewing new possibilities for a direct spiritual influence on material phenomena in the limitation set for the causal mode of description in the analysis of atomic phenomena. For example, when it has been suggested that the will might have as its field of activity the regulation of certain atomic processes within the organism, for which on the atomic theory only probability calculations may be set up, we are dealing with a view that is incompatible with the interpretation of the psycho-physical parallelism here indicated. Indeed, from our point of view, the feeling of the freedom of the will must be considered as a trait peculiar to conscious life, the material parallel of which must be sought in organic functions, which permit neither a causal mechanical description nor a physical investigation sufficiently thoroughgoing for a well-defined application of the statistical law of atomic mechanics. Without entering into metaphysical speculations, I may perhaps add that any analysis of the very concept of an explanation would, naturally, begin and end with a renunciation as to explaining our own conscious activity.

In conclusion, I wish to emphasize that in none of my remarks have I intended to express any kind of scepticism as to the future development of physical and biological sciences. Such scepticism would, indeed, be far from the mind of a physicist at a time when the very recognition of the limited character of our most fundamental concepts has resulted in such far-reaching developments of our science. Neither has the necessary renunciation as regards an explanation of life itself been a hindrance to the wonderful advances which have been made in recent times in all branches of biology and have, not least, proved so beneficial in the art of medicine.

No Room for Scepticism.

If we cannot make a sharp distinction on a physical basis between health and disease, there is, in particular, no room for scepticism as regards the solution of the important problems under consideration, as long as one does not leave the highroad of progress, that has been followed with so great success ever since the pioneer work of Finsen, and which has as its distinguishing mark the most intimate combination of the study of the medical effects of light treatment with the investigation of its physical aspects.

This article is based on an address to the International Congress of Light Therapy at Copenhagen.

The Progress of Television.

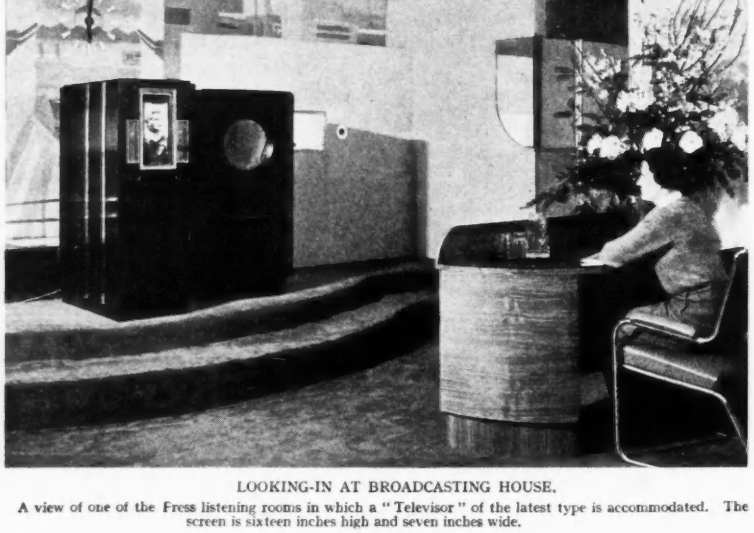
The recent exhibition of television apparatus at the Imperial College, London, makes it appropriate to review some of the outstanding developments of the past few months. These include the latest research on the cathode ray method and the invention of a new mercury vapour lamp which gives the purest white light yet obtained.

THE exhibition of the Television Society at the Imperial College, South Kensington, was the most comprehensive yet held. It left no doubt that television is making definite progress and that it is attracting the increasing interest of responsible research workers. There were special half-hourly demonstrations of ultra-short wave television transmitted by the Baird process from Broadcasting House, and in the intervals the Marconi Company transmitted tape messages from Chelmsford. In the Baird process the picture is, of course, produced by mechanical means. The apparatus, therefore, involves the use either of a revolving metal disc, with a spiral arrangement of apertures through which the light ray passes to produce the picture, or the more modern mirror drum, which similarly builds up the television signals into the finished image.

It has long been known that the cathode ray can play an important part in television. By this means the picture is produced by the rapid movement of an electron pencil on a fluorescent screen. Many experts now think that it is on this method that the future progress of television will depend, but it is still a matter of divided opinion. As long ago as 1928 the late Mr. A. A. Campbell Swinton, F.R.S., contributed an article to *Discovery* in which he expressed the view that cathode rays would provide the solution of television. This distinguished critic of the mechanical method could not then foresee the large measure of success which has since attended the development of the mirror drum, but his early faith in cathode rays has been confirmed by the latest demonstrations of this method.

A few months ago the Baird Company reported that, after extensive experiments, the cathode ray system did not appear at present to be of much commercial value, and that the mechanical method undoubtedly gave better results, having the additional advantage of being simple in operation. A more recent demonstration at the Baird laboratories, however, is evidence that the Company attaches more importance to cathode rays than the earlier report would seem to suggest. As much as 120-line scanning was used, thus permitting very fine detail indeed.

The new "Televisor," in which the small lens is replaced by a large screen to be viewed by a roomful of people, was mentioned in *Discovery* last December. There has been some disappointment at the delay in marketing the new model, since it was demonstrated to the Press some months ago. Meanwhile the B.B.C. has installed a vision receiver of this type with a sixteen-inch screen in one of the listening rooms in Broadcasting House. The image is remarkably distinct, and it is difficult to realize that one is not watching a modern cinematograph display.



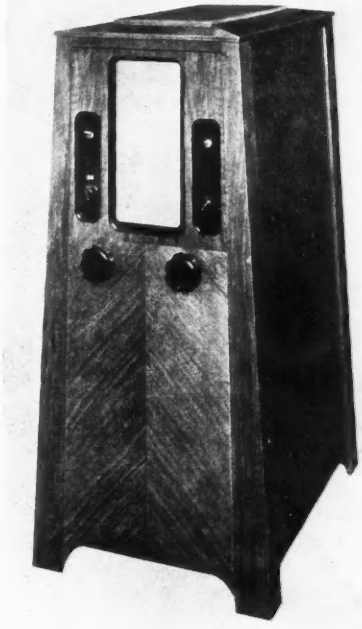
LOOKING-IN AT BROADCASTING HOUSE.
A view of one of the Press listening rooms in which a "Televisor" of the latest type is accommodated. The screen is sixteen inches high and seven inches wide.

Thirty-line scanning is at present used in the B. B. C. television programmes and twelve and a half pictures are transmitted per second. A successful demonstration of sixty-line scanning at the Imperial College was of interest, the detail being of a higher order than usual. Sixty-line scanning is

already used in Rome, where twenty pictures are transmitted per second. Greater detail can, of course, be obtained with the use of more scanning lines.

Further progress has been made in the use of ultra-short waves for television. The ultra-short waves enable images with much greater detail and almost complete absence of flicker to be transmitted. Using only thirty lines it is impossible to obtain an image which is completely free from flicker or which gives the maximum of detail obtainable. In experimental transmissions sent out by the B.B.C. as much as 240 lines have been used in place of the normal thirty lines. Ultra-short waves thus have great possibilities for television.

The televising of the Derby is now ancient history. An even more remarkable development in long-distance television was the recent demonstration on a full-size screen in a Copenhagen theatre of a programme transmitted from London. The signals had to travel seven hundred miles over the North Sea and to contend with a severe storm on the way. Television images are, of course, picked up at greater distances on smaller receivers, but this was the first occasion on which a foreign audience had watched a British programme on the screen. The day is clearly in sight when world-wide television will be as commonplace as modern radio.



A MODERN "TELEVISOR."
One of the latest vision sets similar to the model recently installed at the B.B.C.

One of the problems which television has still largely to overcome is the discovery of a pure white light of bright intensity. The nearest approach to this until now has been the neon lamp which is incorporated in the present "Televisor." But a new mercury lamp was recently demonstrated in New York which is likely to be of special value in television especially for large projectors to be used in theatres. The lamp consists of a highly evacuated glass tube containing a quantity of chemically pure mercury.

An interesting feature of the lamp is the absence of electrical connexions. The glass tube is inserted in a coil through which a current flows. In operation the mercury is heated to a point where vaporization takes place, whereupon the vapour is ionized by induction from the coil and an intense white light is given. When the inventor first started to work on this lamp, he was in search of a source of "cold" light. After much experimental work, he attempted to make use of the dissociation of the mercury atom by the application of a high-frequency. He found that certain effects favourable to the problem could be produced and maintained if the glass tube in which the mercury was enclosed was of a definite shape. Otherwise the tube would not function. Apparently the electrons freed by the breaking up of the mercury atoms had to be allowed to follow chosen paths within the tube, and certain waves of ionization had to be permitted to take place unrestricted. The inventor of the tube believes that about twenty electrons are disassociated from the mercury atom at certain levels of mercury ionization. The principle on which this lamp operates was first suggested in 1887, but all results obtained were unsatisfactory.

Another interesting fact was noted when viewing the images produced with the vision apparatus using the new mercury lamp. The pictures appeared to have depth. When questioned about this the inventor disclosed the fact that there was a large lens in front, that is on the audience side, of the ground-glass plate on which the images were projected. He claimed that this lens produced the effect of roundness or depth. The lens itself is worthy of notice. Since the ground glass screen is about 26 inches square, it was obvious that a huge lens was required. Here is how the problem was solved. A reflector from a large searchlight was obtained, and the silver removed. Then a plate of polished plate glass was cut to the same diameter as the reflector and a frame made to hold both. In the flat plate were drilled two holes near one edge. The two parts were then set up in the frame with rubber gaskets between and on either side, and the whole clamped firmly to the frame. Then 13½ gallons of filtered water were introduced through one of the holes, the other acting as an outlet for the displaced air. Thus was formed a large water lens—said to be the largest ever constructed.

The Progress of Medicine—V.

New Knowledge of Vitamins.

By Ethel Browning, M.D.

Pickett-Thomson Research Laboratory.

Many problems remain to be solved in the vast field of vitamin research, but considerable progress has been made in the last two years, especially in the study of their chemical constitution. Outstanding advances are here reviewed.

SINCE the vitamins are not active principles of drugs used for the alleviation of symptoms, but constituents of the foodstuffs used by man and animals throughout the world, their identification could not be made by ordinary pharmaceutical investigation. The history of the isolation of vitamin D in the form of " calciferol " is a typical instance of the complexity of the investigations in this field, while the monochromatic light technique lately employed by Drs. Bowden and Snow to show the relation between radiations and the constitution and possible methods of production of the vitamins, opens up a new field in experimentation. Further physiological discoveries, if not so spectacular as the physico-chemical, have also been made, and much new light has been shed upon the functions and mode of action of the various vitamins.

Before describing some of these phases of recent research it may be well to give a very brief classification of the vitamins recognized at the present time, with notes on their known functions and properties. Vitamin A has been called the " anti-xerophthalmic " and " anti-infective " vitamin. Deficiency of vitamin A is followed by cessation of growth, the occurrence of xerophthalmia and night blindness, increased susceptibility to infection, pathological changes in epithelial cells, and failure of reproduction. Recently evidence has been brought forward which indicates that vitamin A deficiency is also concerned in susceptibility of the central nervous system to toxic influences.

Vitamin A.

Animal fats and oils are rich sources of vitamin A, cod-liver oil and other fish oils containing high concentrations. Eggs, milk and butter are important sources as are also certain plant products—green vegetables (especially spinach), carrots and some fruits (especially bananas and tomatoes). Cereals are conspicuously poor sources of vitamin A. Many vegetable oils, such as linseed oil, olive oil and cotton-seed oil contain little or none, but red palm oil and some samples of maize oil are good sources.

Vitamin A, a " fat-soluble " vitamin, is probably one of the alcohol series. It is derived from the complex hydro-carbon carotene, the orange red pigment synthesized by many vegetables. It is believed that the change from carotene into vitamin A takes place in the liver. Vitamin A is comparatively stable to heat (it resists temperatures up to 120° C.), but is readily destroyed by oxidation. Vitamin B, originally known as the " antineuritic " vitamin has now been subdivided into six factors (B_1, B_2 and so on), and all are contained in fresh yeast.

Subnormal Growth.

It is now recognized that human beri-beri is primarily due to deficiency of vitamin B_1, and its association with the consumption of milled rice, especially when the diet is deficient in supplementary foods, is attested by abundant evidence. Polyneuritis in birds is also regarded as a pure vitamin B_1 deficiency, while avian beri-beri is believed to be related also to a toxic factor, the product of a disordered metabolism. Vitamin B_1 deficiency has been shown also to be associated with lack of normal growth, with loss of appetite, with anaemia, with degeneration of the sexual glands, and with failure of lactation. It has been claimed to be a potent factor in the production of intestinal stasis.

Yeast and cereals (wheat, maize, rice, etc.), particularly the germ of whole wheat, are the richest sources of vitamin B_1. In cereals generally the endosperm contains less of the vitamin than other parts of the grain, therefore the use of highly milled products from which the embryo, richest in the vitamin, has been removed will markedly decrease the vitamin B_1 content of the diet. The pulses, peas, beans and lentils, and also eggs, are rich sources of vitamin B_2, while some green vegetables (especially watercress and lettuce) contain large amounts. Vitamin B_1, belonging to the group of " water-soluble " vitamins, has been isolated as a crystalline compound containing sulphur. It is stable to temperatures up to 100° C., if not long continued, resistant to acids, but readily destroyed by alkalies, even at low temperatures. It withstands desiccation and oxidation.

The fact that vitamin B_2 usually occurs in the same food-stuffs as vitamin B_1 has made special methods for their separation necessary. Heating, sufficient to destroy the antineuritic vitamin destroys also some of the vitamin B_2. Adsorption on fuller's earth,

removing vitamin B_1 and a little of the vitamin B_2 and precipitation by lead acetate, carrying down the greater part of the vitamin B_2 are the two methods chiefly used.

The preventive power of vitamin B_2 in human pellagra has been established by the researches of Goldberger and his colleagues, though its exact etiology and the part played by maize and the low content of the diet in " biological protein " is not yet fully understood. The occurrence in rats of a symmetrical dermatitis, similar to that of pellagra, when fed on a diet deficient in vitamin B_2, together with a complete cessation of growth, has been observed by many workers, but the lesions are not constant.

Except in egg-white, which contains vitamin B_2 and is devoid of vitamin B_1, the distribution of the two factors is generally the same qualitatively but differs quantitatively. Meat and milk are much richer in vitamin B_2 than B_1, while the reverse is true of egg-yolk and green vegetables. Similarly wheat, which is one of the richest sources of vitamin B_1, is poor in vitamin B_2. Vitamin B_2 is not yet a well-defined chemical entity. It is more heat-stable than vitamin B_1, but its resistance to heat is lowered in an alkaline medium.

Vitamin C is the antiscorbutic (water-soluble) vitamin. The relation between lack of vitamin C in the diet and the development of human scurvy was clearly established even before the experimental production of scurvy in animals provided complete confirmation. Fruits and vegetables are the richest sources of vitamin C, the citrus fruits and tomatoes being of greater value than grapes, cherries, plums and peaches. Meat and milk are variable sources, though fresh meat has some antiscorbutic value, while eggs and cereals (except when these latter are sprouted) are practically devoid of it. There has been some controversy as to the existence of a " precursor " of vitamin C in the form of narcotine, a substance formed during the ripening of fruit. This will be discussed with other recent advances in vitamin knowledge. Vitamin C is very sensitive to oxidation, to alkalies and to heat.

Developing Bones.

Vitamin D is the antirachitic calcifying (fat-soluble) vitamin. The specific function of vitamin D in controlling the calcium phosphate metabolism of the body relates it very closely to the development of the bones and teeth. The occurrence of rickets is related to a complexity of factors other than the actual lack of vitamin D-containing foods. The production of vitamin D in the skin by exposure to ultra-violet rays, the mineral constituents of the diet, particularly calcium and phosphorus, and the antagonistic effect of cereals to vitamin D, are some of the conditions which determine the incidence of rickets in human beings. In the case of osteomalacia special conditions of deprivation of vitamin D (lack of sunlight) and a frequent association of pregnancy are recognized as the most important determining factors.

The appearance of pathological lesions in animals—loss of weight, anorexia, diarrhoea and deposits of calcium in the arteries, heart, lungs, kidneys and stomach—following large doses of irradiated ergosterol has made hypervitaminosis D of practical importance in pediatrics. There is, however, a wide margin between the therapeutic and the toxic dose, so that with care in administration the danger would not appear to be very great. The chief sources of vitamin D in the ordinary food supply of human beings are milk, butter, eggs and to some extent green vegetables. The richest sources for therapeutic purposes are cod liver oil and the various forms of irradiated ergosterol.

Cure of Rickets.

The fact that various foodstuffs, incapable of themselves of preventing or curing rickets, become antirachitic on exposure to ultra-violet light has greatly extended the list of agents available for the prevention and cure of rickets. Chief among these foodstuffs is milk, some workers believing that irradiated milk owes its beneficial action to some unknown constituent other than vitamin D.

The discovery of the parent substance of vitamin D in the form of ergosterol, was made in 1927. On irradiation of ergosterol a complex mixture of substances is formed, one of which is vitamin D. The isolation of a crystalline compound termed " calciferol," formed by irradiation of ergosterol, which is claimed to be vitamin D in a state of purity, has been one of the most striking achievements of 1932. Calciferol is an alcohol, with the same molecular weight and composition as ergosterol, the conversion under irradiation being apparently due to a rearrangement of the intra-molecular linkages. Although irradiated ergosterol has been found to be unstable, calciferol is remarkably stable under laboratory conditions. It loses its antirachitic activity on heating to a temperature of 180°, and also on further irradiation with long or short wave ultra-violet rays.

Vitamin E is the " anti-sterility " (fat-soluble) vitamin. The part played by vitamin E in the problems of human fertility is still uncertain. In rats, however, its deficiency leads to well defined pathological changes, differing in the female and the male. In the

female sterility occurs, not through damage to the ovary, but through intra-uterine death of the foetus followed by resorption. The condition is curable by ingestion of vitamin E. In the male, incurable sterility develops as the result of degeneration of the germ cells of the testes. The richest source of vitamin E is wheat germ. It is present in small amounts in animal tissues, but practically absent from lard. Milk is a variable and cod liver oil a poor source.

Many Advances.

Both in the identification and preparation of the vitamins and in the understanding of their physiological activity important advances have recently been made. Perhaps the most striking feature in this field is the work of Drs. Bowden and Snow (1932) in determining the actual molecular structure of the vitamins by photo-chemical and spectroscopical methods.

So long as the chemical identity of the vitamins remained undetermined it has been necessary to define their potency in terms of some reasonably stable product which contains the vitamin in question in practically unvarying quantity. This determination has been made by biological testing of the curative or preventive effect of the product in question. The establishment of units has been attended with great difficulties. In June, 1932, a conference of the Permanent Standards Commission of the League of Nations decided in favour of defining vitamin units in terms of standard substances rather than in terms of a biological test. This does not, however, remove the necessity for biological testing.

Recent physiological researches indicate that the clinical value of an antirachitic agent does not necessarily parallel its value in rat units. A discrepancy in the protective dosage of cod liver oil, viosterol, "yeast milk" (i.e., milk from cows fed on irradiated yeast), as judged from their recognized content of vitamin D units, was pointed out in 1931. The daily dose of yeast milk required for the prevention of rickets is approximately 24 ounces (120 rat units) of cod liver oil, 3 teaspoonful (200 rat units), and of viosterol 10 drops (800 units). This inequality in protective power was still further emphasized when it was found that a quantity of irradiated milk containing only 35 units sufficed to protect a large series of infants.

Apparently activated milk not only possesses the advantage of providing an automatic method of preventing rickets, but accomplishes this end by means of an exceptionally small amount of the antirachitic factor. This apparent effectiveness suggests that activated milk contains certain unknown and unmeasured factors other than the recognized presence of vitamin D.

Some discussion has taken place as to the source of the increased amount of calcium in the blood which follows the administration of vitamin D. Recent work shows that vitamin D produces its characteristic action by increasing the absorption of calcium and/or phosphorus from the intestine. In the case of hypervitaminosis, research workers have stated that the increased calcium comes from the bones, where calcium is mobilized and passes into the blood. Other investigators, however, believe that this sequence of events occurs only when the calcium in the diet is deficient in amount. When the diet is rich in calcium the bone stores are less called upon and there is an increased liability to calcium deposition owing to increased absorption from the intestine. It has been suggested by several workers that vitamin D acts by stimulating the parathyroid glands to activity, but the concensus of opinion seems to be that vitamin D functions independently of the parathyroid.

Among many other recent developments may be mentioned the work done, chiefly by Mrs. Mellanby, in relation to the effects of deficiency of vitamins A and D on tooth formation, the investigations on the association between vitamin A deficiency and urinary calculi, and the claim of two investigators to have converted carotene into vitamin A by means of fresh liver tissue.

Kings of Assyria: A New Discovery.

THE discovery in Iraq of a tablet recording the names of Assyrian kings, starting in the third millenium B.C., is announced by a special correspondent of the *Times*. The find was made in the temple of Nabu at Khorsabad by Dr. H. Frankfort, leader of the expedition of the Oriental Institute of Chicago. The tablet contains the names of earlier rulers than those hitherto known, and gives a complete succession down to the eighth century B.C., with the length of the reign of each king and occasional historical notes from the beginning of the second millennium downwards.

Lists of kings, for some periods synchronous in Assyria and Babylonia, have long been known from the tablets excavated from Nineveh and the earlier capital of Assyria, Assur. These lists, in which there are gaps and of which the earlier chronology has been difficult to fix with accuracy, go back to about 2000 B.C., and are supplemented over many periods by an ample historical literature. The full list discovered by Dr. Frankfort appears to cover a number of reigns of which the length has not yet been known.

New Light on a Chinese Manuscript.

By Helen E. Fernald.

Students of Chinese art are familiar with the famous "Hsiang Album." The publication of a beautiful new copy of this sixteenth century manuscript recalls its curious history, and helps to solve some of the problems which it has long presented to experts. The new work is here discussed by a connoisseur.

THE "Hsiang Album" is one of the classics of Chinese art. The mystery attaching to it since it was first brought to light many years ago has piqued the curiosity of every connoisseur. The beautiful copy* prepared by Dr. John C. Ferguson and Mr. Kuo Pao-ch'ang will be welcomed by students seeking to solve the puzzles which the manuscript has presented. Their research explains many of the inconsistencies which exist between the illustrations in the album and the descriptions in the accompanying text.

For those who have not followed the earlier chapters of its story it will be well to summarize the situation as it lay until recent events. It is a fascinating record of adventure and misadventure covering a period of some three hundred and fifty years. The author, Hsiang Yüan-pien, lived from 1525 to 1590, during the reigns of Chia Ching and Wan Li of the Ming dynasty. His home was in the city now called Kahsing; it is about seventy-two miles south of Shanghai on the way to Hangchow. Hsiang's collection of paintings was famous and the impress of his seal has been considered an assurance of high quality. He seems to have been alone in making an illustrated catalogue of porcelains after the fashion of the "Hsüan Ho Po Ku T'u Lu," a twelfth century catalogue of the Imperial collection of ancient bronze vessels, illustrated with woodcuts.

Hsiang went a step further and coloured his illustrations. His taste was for the small fragile porcelains of fanciful and exotic shape, and the ablum depicts eighty-three of these delicate specimens, all of Sung, Yüan, and early Ming date, which were either in his own collection, belonged to his friends, or that he had seen in great houses where he had visited. Delicately tinted water-colour drawings of these pieces together with notes of their date, manufacture, colour, size, price and place of purchase, or where seen, comprised the album. And Hsiang gave it the title "Noted Porcelains of Successive Dynasties."

Hsiang never published his manuscript. When, in the time of his grandson, the Ming dynasty fell and Manchu soldiers sacked the town in 1645, the house of Hsiang was looted of its treasures and the manuscript of the album was presumably carried off with other things to Peking. What its adventures were until it was acquired many years later by the Prince of Yi we can only surmise. We merely know that in 1886, or shortly before, when the famous library and art collections of the hereditary Prince of Yi were being dispersed, the manuscript of Hsiang's album appeared for sale in Peking, claiming to have been in the library of the Palace of Yi for "over one hundred years." Dr. Stephen Bushell describes it as he first saw it, when it was brought to him by a curio dealer. He says it "was bound in the ordinary Chinese fashion in four volumes between rosewood boards." Herr von Brandt, German minister at Berlin, had already seen it and even commissioned a Chinese artist, Li Ch'êng-yüan, to make a copy for him before he turned it back to the dealer. Dr. Bushell recognized immediately the great importance of this manuscript and purchased it. After writing a paper on it for the

A PORCELAIN GOBLET.

A water-colour drawing from Hsiang's album. The goblet is of blue-green ware of the Sung dynasty.

*Noted Porcelains of Successive Dynasties. By HSIANG YUAN-PIEN. Revised by KUO PAO-CH'ANG and JOHN C. FERGUSON, with Chinese and English Text.

Journal of the Peking Oriental Society he carried it to England intending to publish the whole thing in fascimile. But a few months later, in 1887, there was a fire at the repository where the manuscript had been placed for safe keeping, and it was burned together with all Dr. Bushell's notes.

When Li Ch'êng-yüan made the copy for Herr von Brandt he also made one for his private use, and subsequently made many other copies from it both for foreign and home patrons. Therefore when Dr. Bushell returned to China he was able to obtain another manuscript to replace the burned one. It was signed by Li Ch'êng-yüan, however, as having been "copied in the fifteenth year in the reign of Kuang-hsü" (1889) and therefore could not have been the copy made from the original manuscript of the Princes of Yi, but a copy of the copy. Dr. Bushell, however, was satisfied that it was quite true to the one he had possessed before. In 1908 it was published in England under the title "Porcelains of Different Dynasties: Chinese Porcelain: Sixteenth Century Coloured Illustrations with Chinese MS.: Text by Hsiang Yüang-Pien." The illustrations were in facsimile and Dr. Bushell's translation and notes accompanied the Chinese text.

PURPLE TING WARE.
A fragile bowl of the Sung dynasty, acquired by Hsiang for his own collection and copied by him.

It is necessary to describe the perplexities regarding Dr. Bushell's publication in order to show how the new edition by Mr. Kuo and Dr. Ferguson has dispelled them. No one has ever doubted the fundamental authenticity of Hsiang's album, but there were so many inconsistencies in the volume as published by Dr. Bushell that controversy was keen regarding its dependability. The illustrations, especially, were regarded with distrust. At that time, in 1908, fragile porcelains of such early date, as depicted in Hsiang's album, were wholly unknown to the West. Even in China they were almost legendary. If they had really existed they probably all perished long ago. Inconsistencies were obvious between text and illustrations. In one case, for instance, a porcelain, said in the text to be the "same size as the illustration" and to hold three pints, would actually hold only one pint were it really the size of the picture. But, more important, the colours of the illustrations did not always agree with the descriptions on the pages opposite and discussions ensued as to whether the colours were untrue to the original porcelains or whether Dr. Bushell's translations of the Chinese colour-terms were incorrect, or both.

In 1886, Dr. Bushell had described the Kuan, Ko, Ju, and Tung Ch'ing wares as all *green*. In 1908, having decided apparently that the colour-term *ch'ing* leaned to the blue side of the scale, he translated it in nearly every case as *blue*, confusing things further with modifying words. For instance, an illustration of a pale grey-green without any blue in it is described in the text on the opposite page as "purplish blue in colour"; and a *yellow-green* is called "purplish blue of grey tone." The difficulties are such as would suggest an element of colour-blindness. Indeed, it is well known that a large percentage of men are not very sensitive to green. Dr. Bushell may have *seen* blue whenever he looked at greens that were somewhat greyed. He says too, rather naively, in his preface that in the burned manuscript Hsiang's "soft colours were faded, it is true, but their restoration has been materially aided by many details in the descriptive passages." In other words, the colour-term in the text could frequently not be correctly translated without the illustration, but the colour of the illustration had been "restored" according to the term in the text. Writing in the *Burlington Magazine* an expert stated: "Enough has been said to show that in the all important question of colour (I refer to the Sung wares only), Dr. Bushell's edition of Hsiang's album, so far from solving once for all the difficulties of the Sung period, will itself require confirmation on most of the critical issues."

Whatever the explanation of the inconsistencies appearing in Dr. Bushell's publication, the fact remained that they prevented the work from being of much value to the serious student. The most eminent authorities regarded it with suspicion, unable to ignore

it, yet equally unable to base any research upon it. Thus the appearance of an entirely new edition, made under conditions far more favourable for accuracy, is extremely welcome. For some years Dr. Ferguson and Mr. Kuo have been working on a manuscript of Hsiang's album which Mr. Kuo has had in his possession, have found and corrected a number of inaccuracies in the text, have added valuable notes and comments, and have settled the question of colour by a new angle of approach.

That the work of revision should have been undertaken by two such collaborators is a matter for satisfaction. Mr. Kuo has been a life-long student of his country's ceramics, was in charge of the Ching-tê-Chên factories during their brief revival under Yüan Shih-K'ai, and is a collector and connoisseur of note. Dr. Ferguson is well known for his books on Chinese art, and has been for many years adviser in art to the Chinese Government. The two friends have, moreover, had unusual opportunities of studying porcelains, both in the private collections of their friends in China and in the recently opened Imperial Palace collections, to which they have had privileged access during the last few years. They are in a far better position than Dr. Bushell was to understand and appreciate Hsiang's album, for in the Imperial collections they have found many porcelains comparable with those illustrated by Hsiang and can pronounce them no longer legendary, since actual specimens exist to-day. Another factor which aids materially in the revision is that the manuscript which they reproduce is one of the copies made by Li Ch'êng-yüan in 1886 and may therefore have been made directly from the old manuscript of the Princes of Yi (no statement to that effect is made, however). At any rate, it is an earlier copy than the one Dr. Bushell published and was made when its original was still to be seen.

The differences between the new edition and Dr. Bushell's publication do not seem at first glance to be great, but they make all the difference in the world. First of all a discovery is made that explains several puzzles, namely, that the manuscript of the Princes of Yi, which was burned in 1887, was itself a copy, and that it was almost certainly an early copy made before the sack of the House of Hsiang in 1645. In his notes on a certain porcelain, Hsiang says he saw this vase "at the home of Shên, whose posthumous name was Wên Ting." Old records have revealed to Dr. Ferguson and Mr. Kuo that Shên Shih-hsing, who was canonized as Wên Ting, did not die until 1614, twenty-four years after Hsiang's death, and Hsiang, therefore, could hardly have referred to him by his posthumous name. It is a note of respect such as a son might make in copying when he came to the name of his father's old friend. At any rate, it indicates that the copy must have been made after 1614.

A DELICATE CAULDRON.

A beautiful example of Kuan ware in blue-green, seen by Hsiang in the house of a friend at Nanking.

Mr. Kuo and Dr. Ferguson have also good reason for thinking that it was made not later than 1645 and that the manuscript which was carried off to Peking by the Manchu soldiers was the copy and not Hsiang's original. For in the text is another slip, of the sort that could easily have been made by a southern but hardly by a northern Chinese. In the text with another illustration Hsiang mentions the artist Huang Tzŭ-chiu, but the character actually appearing for Huang is another, which is pronounced the same way—*Huang*—in the south, but in Peking sounds quite different—*Wang*. Hsiang himself was too learned a man to make such a mistake in the surname of a very famous artist. The mistake was doubtless made by the same hand that added Shên's posthumous name, and which was probably also responsible for the evident reduction in size of the illustrations and for the fact that the work, although arranged in ten sections after the manner of albums of paintings, was found bound in four volumes.

These discoveries, together with other corrections and comments both on text and on subject matter, make this revised edition extremely valuable. But by far the greatest contribution made by Dr. Ferguson and Mr. Kuo and one which changes the whole status

of Hsiang's work is, strangely enough, not explained or even mentioned anywhere in the new edition. It is that the colours of the illustrations have been verified, not from other copies of copies of the manuscript, not from textual descriptions which are open to various interpretations and so dependable on personal sensations, but from actual existing specimens of porcelain in the Imperial Palace collections, specimens which until lately had hardly been known to exist, specimens of the same wares, of the same dates and presumably of the same colours as those illustrated in Hsiang's book.

The Fate of the Album.

A few years ago who had seen a real example of purple Ting? But there are several examples in the Palace collection and one or two others are now known. The writer has herself seen the tiny purple Ting bowl in Mr. Kuo's own collection, a delicate and fragile piece. The fate of Hsiang's original manuscript is completely unknown; the early seventeenth century copy of it (the Yi manuscript) was burned. We have only copies of that copy, and copies from them in turn. We can never know for certain whether Hsiang's porcelains were the *exact* colour of these illustrations or not. But what we *do* know is that the illustrations in the new edition agree in colour with porcelains *like* Hsiang's which have come down to us and are in existence to-day, and that greater accuracy in the translation of colour-terms has brought illustrations and text into closer harmony.

Mr. Kuo and Dr. Ferguson have included in their publication a valuable table of colour-terms with their English translations. The writer has only one criticism to make and that is that the question of the translation of the term *ch'ing* (green or blue) remains unsettled even in this superb work, for the old inconsistency is retained of translating *fen ch'ing* as pale greenish-*blue* when the colour of the illustrations (which now have been checked by existing specimens) is really pale bluish-*green*!

In some cases the illustrations are even a yellow-green, or a pale grey-green without a bit of blue in it, yet *fen ch'ing* continues to be translated "pale greenish-*blue*." The Chinese term *ch'ing*, like our *orange*, is allowed considerable leeway (according to all those who have commented on it). Why, then, should *pale ch'ing* be always limited to the translation "greenish-blue" and never "bluish-green"? It does not agree with the facts of actual colour of the glaze; and why call a green object blue when the Chinese term itself admits of either blue or green?

Elsewhere Dr. Ferguson defends this translation by drawing attention to the fact that when the Chinese said *fen ch'ing* they meant "the colour of the sky after rain in the process of clearing," a colour which is a delicate greenish-blue very close to the border line between green and blue. The formula for the glaze was supposed to produce this colour, greenish-blue. In the early days it seldom came out in that way, usually turning greener than it was supposed to, but the Chinese called it *fen ch'ing* just the same because their intention was to produce pale greenish-blue. We wish that this explanation could have been incorporated in notes on the examples under discussion, since the question was sure to arise in the minds of all who knew Bushell's edition.

Ordinary colour-terms are at best unsatisfactory; for scientific accuracy they are wholly inadequate. There is wide personal variation in colour-sensitivity as well as in training in the matching and naming of colours. Scientific writings in which colour plays an important part will never be wholly accurate until some standard system of nomenclature is established and vague and poetic general terms are recognized as such.

In regard to the occasional inconsistencies of text and illustration in the matter of size and capacity, Dr. Ferguson explains (and again we wish that the explanation might have appeared in the publication), that Hsiang's notes on size are evidently reliable only in the cases of pieces in his own collection. Where he had to rely upon memory of specimens which he saw elsewhere his drawing may not be the right size or his guess as to capacity may be incorrect. It is only of his own pieces that all the details can be trusted. Otherwise one can hardly suggest the least improvement in this superb piece of work.

Fine Book-making.

The volume is a work of art in itself, one of the most beautiful examples of fine book-making the writer has ever seen. The paper is of exquisite quality; the text, both Chinese and English, is beautifully printed; the illustrations express perfectly the clear, delicate charm of the quaint pictures in the original manuscript. Besides the delightful plates showing the eighty-three pieces of porcelain, the volume is further enriched by the addition of a portrait of Hsiang Yüan-pien and a brief biographical sketch of his life, as well as four illustrations of his ink-palette. The source of the portrait is not given, but the ink-palette is in Dr. Ferguson's possession and has doubtless helped to inspire him to undertake, together with Mr. Kuo, this most valuable work of revision which they have now presented in such beautiful form.

Meteorites and the Age of the Universe.

By E. J. Öpik.

Harvard College Observatory.

A new chapter in meteoric science has been opened by Professor Fritz Paneth of Königsberg. Applying methods similar to those used in determining the age of terrestrial rocks, this scientist derives the age of meteorites from their relative content of helium and radium. The work is being followed up at Harvard College Observatory.

IRON meteorites are assumed to retain helium firmly at temperatures up to 1,000° C., and perhaps higher. It is these meteorites which have been investigated by Professor Paneth. The age derived by this scientist is believed to represent an upper limit of the time that has elapsed since the meteorites possessed a temperature sufficiently high for the escape of helium, the possible over-estimate amounting to only ten or twenty per cent; the accidental error of one determination is estimated at about ten per cent. Paneth's work refers to twenty-four individually different meteorites.

500 Million Years.

He estimates that four meteorites have a limit of 500 million years; four, a limit of 500 to 1,000 million years; six, 1,000 to 1,500; three, 1,500 to 2,000; four, 2,000 to 2,500; three, 2,000 to 2,500; and none above 3,000 million years. It seems significant that all these values fall below or close to a limit supposed to be the age of the earth and of the solar system; from this fact Paneth concludes that all these meteorites must be also of solar origin; he questions the reality of hyperbolic velocities found for the majority of fireballs.

Another possibility evidently does not occur to Paneth—that our stellar universe itself, whence the hyperbolic meteors as judged by their velocities must come, may be not very much older than the solar system. Some time ago it seemed to be the general belief of the astrophysicists that the age of the stars and of the galactic system must be much greater than the age of the earth, being of quite different orders of magnitude. This was really only a belief. From considerations of different kinds of intra-atomic supply of energy, or from the observed parallel motions of stars in moving clusters, one may set certain values as an upper limit to the age of the stellar universe; but whether the stars of our present universe have really existed all this time is a different question; they may be just at the beginning of their evolutionary course.

The obvious non-homogeneity of the galactic structure does not suggest that the mixing of its different constituents—clouds, clusters, moving clusters, widely separated in space pairs of stars with parallel motion—has progressed very far. Stellar velocities seem to depend much more upon position in space and origin, than upon mass; the motions are highly systematical. Before so-called "equipartition" of energy takes place, evidently all kinds of moving clusters and wide pairs of double stars must have been destroyed. From this standpoint the hypothesis of equipartition of energy in stellar velocities must be regarded as extremely artificial; at best, it perhaps may reflect some statistical state inherited from a time when the universe was much more close together than now.

A similar state of affairs may be observed in our conceptions of stellar evolution; great intervals of time must necessarily be postulated for evolution to take place, without positive evidence that the stars really have changed. A star, losing its mass in the form of quanta of light, must decrease gradually in luminosity and mass, going through consecutive stages of evolution which may be now observed simultaneously in the different classes of spectrum and luminosity—classes which, on the conception of evolution, must represent stars of very different ages; if this conception is true, and if all the lost mass goes into radiation, the most generous source of stellar energy—annihilation of matter—must be assumed, in which case the lifetime of a star may be of the order of 5×10^{12} years for a dwarf like our sun, and "only" 5×10^{10} years for a super-giant. However, these are maximum ages; moreover, we do not know whether annihilation of matter really takes place inside a star.

Changing Mass.

Proceeding to the next most powerful source of intra-atomic energy, the formation of heavier elements out of hydrogen, we find the maximum ages in this case 5×10^{10} for the sun and 5×10^{8} for the super-giant. If we still wish to maintain the belief that stars which we observe now have undergone in their past a considerable evolutionary change, passing through stages represented at present by the more luminous and more massive classes, we must find another explanation for the change in mass which must have taken place,

because the synthesis of elements out of hydrogen may produce a maximum decrease in the mass of 0.8 per cent only, which is quite insignificant compared with the actual range in stellar masses. We may assume in this case that the chief loss in mass takes place at the boundary of the atmosphere, through the effect of radiation pressure. However, this assumption appears to be very artificial; the loss of mass from the boundary must in some way keep pace with the evolution of the energy sources in the interior of the star, a process which seems to be somewhat improbable, if not impossible.

Speculations.

On the other hand, if we assume a more recent origin for the present universe, all considerations about stellar evolution become mere theoretical speculations about what will happen to the stars in the far future. The stars have not had time yet to suffer any appreciable loss in their mass, with the exception, perhaps, of the super-giants; their stage of evolution is practically the same as it was soon after their creation. The observed variety in luminosity and spectrum is not the result of evolutional change, but is the reflection of initial conditions: mass and chemical constitution.

The low value for the age of the universe would be in good agreement with the observed recession of the spiral nebulae. Eddington and Lemaitre, in their considerations of the "expanding universe," find time-intervals for the evolution of the universe of the same order of magnitude as the intervals involved in the evolution of the earth. Be that as it may, if we regard the observed motions of the spirals as real, and trace the changes observed at present backwards, we find that a few thousand million years ago the universe was in a peculiar, more concentrated state, from which it started expanding, possibly as a result of some cataclysm. Hence, it is not far to the conclusion that the origin of the solar system was not very greatly separated in time from the origin of the universe itself. The puzzle of the occurrence of super-giants in globular clusters, which are as a rule coexistent with much fainter blue stars (a puzzle which according to Dr. Harlow Shapley sets insuperable difficulties in the ordinary conceptions of stellar evolution), seems also to be explained in the most natural way if we assume that all the clusters are of recent origin, and practically of the same age, the relative ages of the different globular clusters differing perhaps by a few hundred millions of years or so.

There is an indirect method which has been applied by the writer to test different hypotheses as to the evolutional trend and relative age of the stars. The method is based on statistics of distances and magnitudes of double stars. The expected distance of stars is found with the aid of values of the probable masses, estimated on the assumption of continuous evolution with decreasing mass. The distance increases with the mass, instead of decreasing with it; whatever the uncertainty of the observational data may be, it cannot change our principal conclusion: that the different classes of luminosity cannot be regarded as successive stages of evolution of the same kind of objects. Stars of small mass could not have evolved from stars of large mass of the kind we observe now. Either the stars do not change in mass, or the time elapsed since their origin is too short for such a change. It thus seems certain that the stars cannot even approximately be members of the same chain of evolution; the differences in luminosity and spectrum we observe now are due to different initial conditions—mass and composition.

Briefly, the universe—the parent—is not much older than its child, the earth. The perplexing results obtained by Paneth are not perplexing any more. Some of the meteorites he investigated might have come from interstellar space, being as young, or even younger than those belonging to the solar system. Although the observations of velocities of fireballs are not very accurate, it is hard to believe that *all* the hyperbolic velocities recorded are wrong; some of them must be real. Instrumental determinations of velocities of meteors, observed in Arizona by the Harvard-Cornell meteor expedition, indicate preliminarily that from ten to thirty per cent of visible meteors are hyperbolic; we may expect that among big meteorites the fraction of hyperbolic objects is of the same order of magnitude, so that among Paneth's twenty-four samples the chances are strong for finding several strangers from interstellar space.

The Pultusk Stones.

To avoid the necessity of dealing with probabilities, it would be highly desirable to have a case of well determined velocity. Fortunately there exists one such case—the Pultusk stone shower of January 30th, 1868. The hyperbolic velocity of this meteorite stands practically beyond question. The conditions were especially favourable because the meteor was overtaking the earth, and the determination of velocity was a differential one. There were two well trained observers and a great number of others; the real path is determined very well. The average observed velocity was 28 km./sec., corresponding to an average duration equal to 6.7 seconds, derived from twenty-six

estimates; thirteen estimates of duration ranging from 2.5 to 8 seconds. This, together with the fact that the meteor suffered considerable deceleration, ending almost in a full stop at the end of its path, makes the interstellar origin of the Pultusk stones practically certain.

On the suggestion of Dr. Shapley, Professor Paneth undertook the determination of the age of some samples of this meteorite, and found the value about 500 million years[10]—even lower than the average for the iron meteorites. Thus, the low age of the stellar universe is strongly confirmed by this single, but highly significant fact. The mere fact that the Pultusk stones were able to retain a certain amount of helium is an additional chance in favour of its extra-solar origin. Paneth's experiments in heating the Pultusk stones indicate that they do not keep helium better than terrestrial rocks; at a temperature of 265° C. a sample lost six per cent of its helium in three hours.

Lifetime of Helium.

Paneth's research indicates that the "lifetime" of helium in the Pultusk stones at 0° C. (the probable temperature of a stone at the distance of the earth from the sun) may range from four to 40,000 years; at 100° C. the estimated lifetime is from two months to two years. Considering now that the meteor if belonging to the sun must have approached it many times and must have been exposed to temperatures of 0° C. or higher for a total duration of thousands of years in *vacuo*, we should really expect that such a meteorite could retain only a small fraction of the total amount of helium produced during all the time of its existence.

Radioactive estimates of the age of meteorites and of the earth are supposed to give the time that has elapsed since these bodies were in a hot (probably liquid) state. Now, from the standpoint of evolution, the stage of the solid existence of these bodies may represent only a small fraction of all their life; that is, we cannot prove that the liquid state was not preceded by a solid state of the same individual body. In other words, the heating which led to the loss of helium from meteorites, or to the mixing of the lead in the rocks, might have been a temporary, or even a periodical event, in which case the life of the individual body might have been much longer than has been estimated. This is highly improbable, at least in the case of the earth.

The maximum interval of time during which the laws of stability of thorium and lead atoms were the same as they are now is estimated at 6×10^8 years.

MODERN INDUSTRIAL LIGHTING.
A corridor in Unilever House, London, showing the modern lighting arrangements.

Before this time, certain conditions must have existed unfavourable to the accumulation of lead; either lead was destroyed, or thorium did not exist, being built up later; or a reverse process of building thorium out of lead was going on. With the present state of our knowledge, it seems likely that only at the very high temperatures of stellar interiors, the stability of the elements may be different from what it is under the conditions possible in our laboratories. A body of such small mass as our earth could hardly attain a central temperature sufficiently high for atomic transmutations without blowing up by radiation pressure. Thus, we conclude that less than 6,000 million years ago the earth must have formed part of a larger body, the central temperature of which was high enough to invert certain radioactive processes. We find that the time elapsed since the beginning of the individual existence of the earth until the formation of the solid crust could not be much greater than the age of the crust itself; this points to a rapid course of evolution in the beginning.

Age of the Universe.

Concluding, we may say that the combined evidence presented by meteorites, by statistical data relating to wide double stars, by the distribution of stellar luminosities in globular clusters as pointed out by Shapley, and by the observed recession of spiral nebulae (whatever the interpretation for it may be), once we assume that the recession is real, all this evidence points to an age of the stellar universe of the same order of magnitude as the currently accepted age of the solar system: not much more than 3,000 million years.

Book Reviews.

The Technique of Early Greek Sculpture. By STANLEY CASSON. (Clarendon Press. 25s.).

Archaic sculpture, as everyone knows, is in the mode. The reaction from Lessing's *Laokoon* is complete, so that even Phidias is undervalued and the smooth competence of the Hellenistic school is ridiculed. Our most popular modern sculptors revel in what to the older generation seem harsh forms and bizarre conceptions, and therefore the primitive works from Knossos and Mycenæ and early Attica find more favour than they have enjoyed for thousands of years. The change of fashion is, of course, too violent to endure and tends to encourage insincerity and pretentious absurdity. But it is good in so far as it challenges outworn conventions and stimulates the originality which is the soul of art. It is good, too, in that it promotes that intelligent study of early sculpture of which Mr. Casson's new book is a shining example. Here is a learned archaeologist, whose articles on Greek and Byzantine art are well known to readers of *Discovery*, discussing Minoan and Attic sculpture with a full knowledge of the modern sculptor's aims and methods. While using all the literary sources, he has also made a close technical examination of the ancient works so as to find out exactly how they were made and thus to throw light on their makers' objects and ideals. It is a difficult book, despite the many excellent photographs and drawings with which it is illustrated. But it will repay the close attention that it demands, because it illuminates the whole subject, whether from the artistic or from the cultural standpoint.

The prehistoric art of Knossos and Mycenæ, to which the first chapter is devoted, is separated from that of early Greece by a dark age of at least three centuries (1200-900 B.C.). It produced some fine things, influenced to some extent by, but yet essentially different from, Egyptian work. Large stone statues were not made; the votive figures appear to have been of wood, like the oldest Japanese statue of which the British Museum recently acquired a copy, though the Minoans probably covered the wood with gold-leaf and added a bronze head covering. Mr. Casson shows that emery from Naxos or some similar abrasive was largely used in working the hard stones; the sculptors were in no hurry, and had no bronze tools except a tubular drill, such as the gem-cutter employed, and a saw which often had emery teeth. The bronzes were cast solid and left rough; the *cire perdue* process was unknown. When Knossos and Mycenæ fell and the Northern barbarians swept down upon Greece, many of the old wooden idols continued to be venerated in out of the way shrines, but the Cretan technique was forgotten. The "Geometric" age of early Greece slowly developed new methods, and rival influences from Asia, both Hittite and Assyrian, and from Egypt are seen at work in the Hellenic world. From this point onward Mr. Casson's minute study of the sculptor's technique becomes of absorbing interest. The workers in soft stone followed the methods of the wood-carver. But the worker in marble had to use very different tools for his intractable material, and his development is clearly explained by detailed analysis of typical works such as the Athens Dipylon head of the seventh century, the exquisite Kore of the sixth century, also at Athens, and the "Seer" at Olympia. It is curious that the drill, which a modern stone-worker regards as indispensable, was not used by the Greeks for cutting grooves till 500 B.C., though, centuries earlier, the Minoans employed the tubular drill for the same purpose.

The methods of bronze working were perfected by the fifth century but there remained an unlimited field for invention, such as the Attic sculptor loved, in the carving of marble and other stones. Mr. Casson does not wholly agree with the suggestion that bronze work had a profound influence upon stone sculpture. Doubtless the popularity of the bronze statue put the sculptor on his mettle and led him to make new experiments. But bronze and marble are so unlike as to require different treatment, and the Greeks were too artistic to overlook that fact.

Forty Years for Labrador. By Sir WILFRED GRENFELL. (Hodder & Stoughton. 15s.).

With this fascinating book Sir Wilfred Grenfell brings up to date the record of his life in Labrador, first told fifteen years ago in "A Labrador Doctor." It is a unique story of hardship and endurance through many years of unstinting service, recorded with characteristic modesty and restraint. The author went to Labrador in 1892 and conditions then would have been sufficient to repel a visitor of less determination and less sense of duty. There were no lighthouses on the coast and no roads on the land; the inhabitants were incredibly ignorant and were governed by superstition. Sir Wilfred Grenfell set himself an immense task, and his accomplishment of it needs no repeating here.

The book has many exciting episodes, for the author has entered fully into the life of the country. Writing of a seal-hunting trip, he says "It is the physical excitement of travelling over broken ice, tossing on the bosom of the mighty ocean, with the skill and athletic qualities which the work demands, that makes one love the voyage. Jumping from the side of the ship as she goes along, scurrying and leaping from ice-pan to ice-pan, and then having killed, 'sculped' and pelted the seal, the exciting return to the vessel."

The flora and the fauna of the country, the author writes, are so varied and exquisite that one wonders why the world of science has so largely passed the country by. This omission is now, of course, being repaired. Sir Wilfred points out that not only the ethnologist and botanist, but the archaeologist as well could reap a harvest for his labours there. Many relics of a recent stone age still exist. It is, of course, the Eskimo custom to entomb with the dead every possession which he might want hereafter, since the spirit of the implement is thought to accompany that of its owner.

It has long been known that Labrador possesses mineral deposits which in the future may prove of great value, but difficulties of communication, transport, and mining operations have left these sources of wealth practically untouched even to-day. It is the production of paper from wood pulp, the development of hydro-electric power, wireless and aeroplane communication, and electrical prospecting which is bringing this land to the front, so rich in forests and water power. It is now known both from the reports of exploring parties and from aerial surveys that the hinterland of Labrador possesses huge preserves of timber, unlimited water power form her tremendous falls, and the potentiality of minerals indicated by the nature of her rock formation, for it is the same as the Canadian Shield which only a little further west has yielded the largest gold and silver, nickel and copper deposits in the world: "It was a far cry from Labrador to 'civilization.' All the same, we are already being permitted to see on our northern coast the dawn of a new day; for just as Canada, that once useless 'Lady of the Snows,' has come into her own, just as Alaska, stigmatized

but a short while past as 'Steward's Folly,' has claimed her place among the servants of man, so Labrador, a sleeping, chilly giant, is stirring, and her forests already ring with the tools of the surveyor and engineer."

Alfred Mond, First Lord Melchett. By HECTOR BOLITHO. (Secker. 21s.).

When the economic history of the post-war years can be written in perspective, the appearance of "rationalization" will be noted among the important developments of the period. The movement towards large-scale units in industry is still in its infancy, and it is therefore interesting to read the life of the great English industralist who was the first to put rationalization into practice on a large scale. The biographer does not tell us whether Lord Melchett claimed to have "discovered" this term, but it was significant that, shortly before his death, he was asked to define it by the editor of "Nuttall's Dictionary."

Though he is chiefly remembered as the founder of Imperial Chemical Industries, Ltd., it will surprise most readers to learn that Sir Alfred Mond put politics first in his ambitions and only devoted himself to business in the last few years of his life. It would be difficult to imagine a more unpromising start than was made by this future leader of industry. After failing in his examinations at Cambridge, where poker seems to have been his chief occupation, Mond spent ten years reading law before he went into the family business. The figure of Dr. Ludwig Mond dominates these early years and though Alfred owed so much to his influence, it is clear that the father completely overshadowed the son, who developed late and suffered so acutely from a sense of physical inferiority that he once vowed he would never marry. As it was, even after years of success in politics and business, his German origin and guttural speech were a constant handicap, and during the war he was subjected to the most degrading calumny on this account, notwithstanding that he had served in the Cabinet and that his son of sixteen was already fighting in the front line.

If Mond was born with a silver spoon in his mouth, he certainly had to struggle throughout his life against tremendous personal odds which made his achievement all the more remarkable.

A large part of this book is devoted to politics, but his Parliamentary career is chiefly interesting for the part it played in his business development. The Free Trade campaign of which he was a leader for so many years, expressed his passion for freedom, and when Mr. Lloyd George's agricultural policy became a dominant issue in the party, Mond at once recognized it as a form of public control which in any form was anathema to him. His transition to the conservatism was an inevitable step in the light of this controversy, which illustrated his gift for going straight to the underlying principle of any question, which was perhaps the secret of his remarkable success in business.

Shortly after his return to business, Lord Melchett convened the famous Melchett-Turner conference, which was a milestone in the relations of capital and labour, and gave rise to many of the proposals which were shortly put into practice in the great chemical combine which he founded. Mr. Bolitho's account of the dramatic moves which led to the formation of Imperial Chemical Industries reads like a novel, and it may be regretted that more space is not given to this culminating chapter in his subject's career. But Lord Melchett was interested in so many activities and no sooner was this great scheme effected than he passed on to vigorous steps in connexion with Zionism. In his son's opinion this was the one great passion of Mond's life, and he had bought a large estate on the shores of Lake Galilee, to which he looked forward to years of retirement. But that was not to be, for worn out by work he died after a brief illness at the early age of sixty-two.

Lord Melchett inherited from his father a taste for art, and collected many treasures at Melchett Court, which he loved to show to friends. This many-sided man, who knew to the full the delights of commercial achievement, was also a philosopher, and in one of his last addresses he expounded the view that "living" was something more than going to an office. "Machinery is there to provide us with leisure and not to give us more work; transportation is there to give us more time, and not less."

A Catalogue of Original Manuscripts, Presentation Copies, First Editions and Autograph Letters of Modern Authors. (The Rosenbach Company, Philadelphia and New York.)

Age lends interest to most things, and in the case of manuscripts it is safe to say that the older a literary discovery, the more likely will it be to arouse curiosity. Yet modern authors offer a fascinating field for research in this respect, and some of their most famous books hold secrets which only the manuscript can reveal, these being often hidden from the critics for many years after publication.

No doubt with such thoughts in mind, the publishers of this catalogue describe it as "a study in reputations." It includes the works of authors, some of whom were appreciated immediately by their contemporaries, others only after many years of literary failure. The authors represented are not so old that there are not people who have seen both the rise and consolidation of their reputations. It is stated that never before has such a collection of the original manuscripts of Conrad, Crane, Hearn, Stevenson and Wilde been offered for sale. These manuscripts are among the most famous productions of their authors' pens, such as "Nostromo," "An Outcast of the Islands," "Dr. Jekyll and Mr. Hyde," "David Balfour," "Ticonderoga," "Salome," "Glimpses of Unfamiliar Japan," "In Ghostly Japan" and "The Red Badge of Courage." All of them are essentially great and time will increase their reputation.

The meticulous care, the numerous corrections, the large bold calligraphy portray for us the Polish sea captain writing laboriously and thoughtfully in an adopted language. By contrast, a free round and very running hand, sometimes flowing with such speed that the words are almost illegible, speaks eloquently of Stevenson's quick, brilliant mind, his ability to grasp an idea and almost simultaneously to phrase it. While surely Wilde held a poppy or a lily in his hand as he wrote "Salome," for the affected Greek "a," and the general appearance of studied effect give an impression of the classical scholar and the aesthete.

The rarest book in the collection is the only known copy of Barrie's first published effort, a translation of Horace Odes III, 21, written and published while Barrie was a scholar at Dumfries Academy in 1878. In spite of the highly developed detective powers of modern bibliographers, this work has hitherto successfully eluded all their researches.

Among Kipling first editions offered in this catalogue are copies of "Schoolboy Lyrics," "Echoes," and "Quartette." There is also the complete run of the *Pioneer* published in Allahabad and purchased directly from the proprietors of that newspaper, in which many of Kipling's best known poems and

stories made their first appearance. This is described as the most important Kipling item that is known to Messrs. Rosenbach and it is not represented in any of the great collections of this author.

Mark Twain's own copy of "Huckleberry Finn," with his signature on the inside of the front cover, and the first issue of the first edition of "Tom Sawyer" are worthy of special mention in a collection of Twain "firsts," most of which were his own copies. Of the utmost rarity is a copy of Stevenson's "Ticonderoga," the first issue of the first edition, of which only three copies were printed. There is also the presentation copy of "Underwoods" on large paper to Will H. Low to whom some of the poems in the volume were written.

Although it includes many such finds, this catalogue is not planned to appeal alone to the seasoned collector, but to those who have just fallen into the frenzy of bibliomania and wish to try the pleasures of collecting, dipping a tentative toe into the water before taking the final dive. Everyone must start at some point, and there are few who can start at the top. Part of the catalogue is devoted to autograph letters, the element of surprise being one of their most appealing features. The publishers conclude their introduction with an apt quotation from Erasmus. "If I have any money I buy books; if I have any left over I buy food and clothing."

History as a Science. By HUGH TAYLOR. (Methuen. 10s. 6d.).

This is an interesting and suggestive book on an inexhaustible subject which comes up and dies down again from time to time in literary discussion. The contention of Mr. Taylor is that the study and the writing of history are in a very unsatisfactory condition; and that this "is largely due to the conflict in the mind of the historian between the interests of conduct and the interests of knowledge." Historians, he maintains, profess to be scientific, to deal strictly with observation and the collection of facts. Their avowed aim is to discover truth and to promote knowledge. But actually they are under a double allegiance—or rather, a double servitude—to knowledge and to morals. The historian is always being drawn away from the strict pursuit of truth, from the scientific handling of his evidence, by his desire to promote morality. "It is well known that the significance of evidence varies with the emotional condition of the observer, and the majority of historians have approached their task in a frame of mind which has rendered them liable to see only what they wish to see, or even what is not there at all, and to impart into the interpretation of events considerations which exist only in their own minds."

Mr. Taylor rightly holds that this double aspect of history, its affinity to knowledge, and to morality, is its great attraction; it gives to history a universal appeal, and has ensured it a leading place in every educational system. With all this universal attention and effort given to it, the performance of the historical profession should be of the greatest; it should have "stimulated a progress greater than that of any other study, and this anticipation is very far from being realized"—for actually, the results are rather poor. Such is Mr. Taylor's view, and there is much reason in it. Most histories are biassed, many extremely biassed. Defenders have tried to maintain that bias gives interest to a history and helps its literary quality, but this is a very superficial view. Mr. Taylor soundly says that a new method must be applied in historical study—but what method?

Mr. Taylor works out his arguments in four interesting chapters on "The Object of History," "Government and History," "War and the Study of History," and "Revolution and the Study of History." The last chapter deals with "Machiavelli and Morality." All this is well done and well worth reading. It is, in fact, a criticism of modern historical education. The faults of the present method are lucidly explained; but the way to avoid those faults is not described with anything like the same precision or elaboration. We are left with the impression that while Mr. Taylor accuses historians of using history to put forward their own views, he tends, in his own criticism of them, to fall into the same error.

Introduction to the Phonology of the Bantu Languages. By CARL MEINHOF. Translated by N. J. v. WARMELO. (Williams & Norgate. 20s.).

We welcome the English version of Professor Meinhof's "Grundriss einer Lautlehre der Bantusprachen," the first edition of which appeared at Leipzig in 1899 and a second in Berlin in 1910. As long ago as 1910 Dr. Alice Werner pressed for an English translation and even began the task herself, but pressure of work prevented her continuing. In 1928 it was taken over by Dr. N. J. v. Warmelo, who is to be congratulated on finding neat equivalents for *leichte* and *schwere Vokale* and *Mischläute* (open and close vowels and palatals). To suit English readers, the chapters dealing with Herero, Sangu and Duala, languages of South West Africa, have been replaced by chapters on Zulu and Kongo, as being of more general interest.

As the book is intended for the use of officials, missionaries, traders and others who are not professed philologists, the detailed explanatory chapter will be of very great use, for it is really an introduction to the practical study of phonetics: the principles are applicable to any language, so that the book will be a useful companion to those in the field studying Asiatic and American tongues. The languages dealt with in detail are Pedi, spoken by a tribe of the Basuto, Zulu, Swahili, Konde and Kongo, five very representative tongues. Perhaps it is worth repeating here, to correct a widespread delusion, that the clicks for which Zulu and Xosa are famous are definitely not Bantu sounds, but loans from Hottentot and Bushman languages. In Zulu there are three clicks, but they are not so terrible as they sound; we have at least two of them in English. The *c* or dental click is usually spelt in English "tut tut," the *q* or cerebral click represents the pop of a cork, while the *x* or lateral click is regularly used by English coachmen to cheer on their horses. At the same time, we must admit that for the layman it is rather dreadful to read that these clicks may be aspirated and even accompanied by a glottal stop. The latter we have too in English; it is the catch in the breath that replaces *p* in the mouths of London newsboys. It takes considerable practise to make fluent use of these sounds. As a matter of detail, in the chapter on Swahili, the forms *-ja* (*-ya*), "come," *-yaa*, "be full," and *-jua*, "know," are marked "M," that is the Mombasa dialect, when in fact they are Kiami (Lamu dialect): as a matter of fact, these particular words are the same in Mombasa and Zanzibar dialects.

It is interesting that Meinhof has established a hypothetical Ur-Bantu on the principles of the reconstruction of a hypothetical primitive Aryan. The map showing the distribution of the languages is useful, of which it locates 149. The area of Chokwe is shown north of Lat. 10° S., with Kimbundu to the south of it, shown as though a place-name, but the area of Chokwe extends southwards well beyond Lat. 11°S., to the Lungue

Bungu, beyond which it yields to Luchase. There is some confusion here. All concerned in the production of this great work are to be congratulated. The reading of the proof alone must have been a monumental task.

Byzantine Civilization. By STEVEN RUNCIMAN. (Arnold. 16*s*.).

This small volume of 320 pages will serve well as a handbook to Byzantine life and history. But it will hardly serve for more. The subject is dealt with under various headings, such as History, Law and Constitution, Religion, Commerce, Army and Navy, Education, Literature and Art. Nothing short of five volumes would cover the ground even with tolerable success, for the vastness of the subject and the long millenium with which it is concerned give a mass of material which a book of this size could not hope to compress. The author has thus fallen between two ideals—tremendous compression and swift delineation. In effect he achieves neither and only one would have afforded success. The historical outline, for instance, gives a mass of names and dates and events and no indication of the general trend of history: the chapter on Literature, like that on Art, gives a general sketch devoid of detail and unilluminated by any keen perception of vital elements in the subjects discussed.

So much by way of complaint, inevitable in any book on a thousand years of complex and almost over-documented history. But Mr. Runciman gives us gleams, delightful and trenchant, of the odd neurasthenic world of Byzantium. A city which started its life of world-conquest by enduring almost at the outset nearly a century of continuous seige and attack from barbarians, was not a place where culture and contemplation could generate easily. It was to these years that we must attribute that growth of cruelty and cynical violence which at times mars the course of Byzantine life. But despite that drawback Byzantium, by virtue of its Greek spirit, remained the very core of civilization. Slowly the contrast with the Roman Empire and then with the Roman Church emerges. Byzantium never spoke Latin after the age of Justinian and even the Emperors could not read it in the fullest times of Byzantine learning, for Latin was to the East Greeks the symbol of barbarism. So Greek were the citizens of the greatest city of antiquity! Mr. Runciman does not probe to the bottom the causes which led to the collapse of the Empire in 1204 and the Latin occupation. They are deeper than he indicates and give the clue to Byzantine character. Nor does he discuss the Laws of the various Imperial Codes which throw a strange light on the culture of the times.

A few misprints are noted and one strange blunder, the attribution of the Greek philosoj her Anaximander to the fourth century B.C.! But the book is authoritative and well written. Students of Byzantium cannot disregard it.

Caravan Cities. By M. ROSTOVTZEFF. (Clarenden Press. 15*s*.).

By the title of his book Professor Rostovtzeff indicates the orientation of his interest in the archaeological exploration of the four cities of antiquity with which he deals. They were halting places for the caravans which used the great trade routes across the deserts lying between Mesopotamia on the one side and Egypt and the coastal belt of Palestine and Syria on the other—Petra and Gerasa (Jerash) on the southern route and on the northern, Dura on the Euphrates and Palmyra on the road to Damascus. The desert, as the author points out, was like the sea; it united as well as divided, and these caravan cities were its ports. The wealth which they acquired as the result of the caravan trade, and the mixed population which gathered within their walls, developed a civilization which excavation is showing to have been possessed of peculiarities all its own. For example, their function and importance as a caravan halt finds expression in an imposing caravanserai.

Professor Rostovtzeff has himself been engaged in excavating three of these four cities with American expeditions. Unfortunately, up to the present it has not been possible to learn anything of their earliest history, and for other reasons the author has felt himself constrained to confine his attention to the description of one period only, that of Hellenistic and Roman times. Dura was founded as a Macedonian military outpost. Though not in itself of the first importance, it has so far yielded the most valuable and instructive material. This is especially so in connexion with Christian art in the third century and in the light it has thrown on the little known culture of the Parthians, who held the town for the greater part of the period under review. In dealing with the northern trade route the author frequently has to deplore the lack of detailed knowledge of Parthian civilization—a defect which he trusts will be remedied by further excavation both at Dura and Palmyra. As he shows, an excellent beginning has been made.

The author's skilful treatment of his material does full justice to the absorbing interest of his subject, and the introductory chapter, in which he surveys the growth of desert trade routes from prehistoric to Byzantine times with special reference to geographical and cultural conditions, is masterly.

A Short History of the World's Shipping Industry. By C. ERNEST FAYLE. (Allen & Unwin. 12*s*. 6*d*.).

Mr. Fayle's compact and well-balanced history of the shipping trade, as distinct from ships, is both informing and attractive. He begins with the Egyptians, Phoenicians and Greeks, and notes the beneficent work of the Roman Empire which for several centuries kept the Mediterranean free from pirates. Coming to the middle ages, he shows how the Italian ports, especially Venice and Genoa, developed maritime law and marine insurance and built up a great shipping trade only rivalled in Northern Europe by the Hanse towns. Holland took the lead in the sixteenth century, partly because the herring left the Baltic for the North Sea and partly because the Hanse towns and the Italian ports were decaying as the result of political changes. Seventeenth-century Holland, owning nearly half the world's shipping and monopolizing the East Indian trade, was unrivalled also for her sound finances and her skill in running ships cheaply. England overtook her in the eighteenth century, when Lloyd's developed the underwriting market and Lloyd's Register set higher standards of shipbuilding. Apart from the East Indiamen which were owned by a small ring of favoured capitalists, the industry was open to all who cared to invest their money in merchantmen and it grew very rapidly. Mr. Fayle does not think that the Navigation Acts had much effect after 1750, since many exceptions were made to the rule that foreign goods could only be imported in the vessels of the country producing the goods or in English vessels, and in any case English shipowners could face all competition. Before and after Waterloo, American ships, cheaply built of soft wood, were formidable rivals in the Atlantic trade. But they were less durable than English ships built of hard woods and, like other sailing ships, they were unable to compete with the early

steamers with which England regained the American passenger trade. It is curious to be told that, when iron ships were introduced, America found it impossible to build them as cheaply as England; but America's iron and steel industries did not grow fast till after her Civil War. After that, no doubt, the rapid expansion of trade and manufacture in all parts of the Union diverted young Americans' attention from the sea to the land. Mr. Fayle brings the story up to the present day and ends on a somewhat pessimistic note now that the world's shipping appears to be in excess of the world's immediate needs. The book is illustrated with some excellent prints from the famous Macpherson collection, which is soon to be shown in the new Naval Museum at Greenwich.

The Underworld of India. By SIR GEORGE MAC MUNN. (Jarrolds. 12*s*. 6*d*.).

The Indian underworld of which Sir George Mac Munn writes is not necessarily criminal, although it includes the extensive and varied criminal tribes and classes. It is the world of the outcaste and the depressed classes. Those of them who stand within the ranks of Hinduism, suffer from many disabilities, of which one of the most serious is exclusion from the Hindu temples. They constitute one of the two major problems of social and political India to-day. Sir George describes these peoples—the sweepers, water carriers, leather workers, washermen and other castes of menial occupation, the mendicants, the temple women and other courtezans, the criminal tribes and the like—as they are in every-day life and the part they play in the social organism. His account of them pictures the variety and colour of Indian life in a vivid manner that recalls Kipling's description of the great trunk road in "Kim." He does not hesitate to speak plainly of the darker side.

In a valuable exposition of certain aspects of the every-day life of India, two points are stressed. The first is the deep-seated place of caste in Hindu life, leading to a complete disregard by the higher castes, the Intelligenzia, of the interests and welfare of the lower, except when a political purpose is to be served; and secondly, the all-absorbing character of the sex-cult in Hindu social and religious life, which, the author holds, constitutes an impassable barrier to the free intercourse of East and West. The text of this readable book is unfortunately marred by many missprints and other textual errors.

Untold Miles. By MICHAEL TERRY. (Selwyn & Blount. 18*s*.).

Mr. Terry, who has written much on Central Australia, describes in his new book three prospecting expeditions of 1930-31 to the hill country east and west of the border between South and West Australia, hundreds of miles from a railway. As his main purpose is to portray the daily toil of the prospector in a wild but picturesque region, the author enters into minute detail and adopts a colloquial style which is perhaps somewhat fatiguing for the reader. His party used a motor lorry, with camels for reconnoitring, and thus were able to cover great distances with little risk. They worked first in and near the Petermann Ranges and later in the Warburton Ranges to the north-east of Kalgoorlie. Many weeks of prospecting yielded little or no indications of gold. But Mr. Terry speaks enthusiastically of the scenery and suggests that tourist traffic to these unmapped wilds might be developed with advantage. As he says, if the numerous prospectors who have worked in this region had all recorded their results, its true character could by now be determined. But the district is probably not auriferous, though on the other hand it must be remembered that the first reports on Broken Hill were profoundly discouraging. The author writes sympathetically of the blacks and tells some curious stories about them. In one case a "boy" in hospital at Kalgoorlie suddenly put his ear to the ground and called out, "Dick bin die, finish." It was found that his brother Dick, a hundred miles away, had died at that moment. The book is illustrated with many photographs of the remote interior.

A Psychologists' Point of View. By CHARLES S. MYERS. (Heinemann. 7*s*. 6*d*.).

This collection of essays and addresses by one of our leading psychologists reflects the author's originality of thought on many subjects. The majority of the essays are naturally scientific, and two deal with religion—one with prayer and a second with "individual religious difficulties." Writing of instinct and intelligence, Dr. Myers suggests that there is no essential difference between them: instinct regarded from within, he says, becomes intelligence; intelligence regarded from without becomes instinct. As a psychologist the author distinguishes between two forms of vocational education—centrifugal and centripetal; the first proceeds outwards from a narrow and specialized centre; and in the second the process is reversed, beginning with broad principals and proceeding inwards. The author thinks that the choice of method should depend on the intelligence and mental equipment of the student.

Dr. Myers has a keen and practical insight into many current problems and his observations are entertaining and instructive.

Northmen of Adventure. By CHARLES MARSHALL SMITH. (Longmans. 16*s*.).

The author's aim in this book has been to portray certain dominant individuals of a dominant race. This grouping of history round the careers of its principal representatives is appropriate in telling the story of the Northmen because it is the method of the sagas, and it is in the sagas that the history of the Northmen lies embedded. The Northmen have always been of special interest and attraction to Englishmen because we inherit many national characteristics from them. It is from them, as the author says, that we have inherited our instinct for the sea, our facility for switching from fighting to trading, and "our ability to effect a compromise between communal living and personal freedom." Mr. Smith tells again the story of Odin, of Harald Fairhair and of Cnut, of Rurik of Russia and Eric the Red. It is a stirring record, admirably told, with many illustrations.

Street Traffic Flow. By HENRY WATSON. (Chapman & Hall. 21*s*.).

Television and autogiros will in future be used to assist in controlling city traffic, according to the author of this book, who has made a study of the problem in all its branches. In future, he says, the central areas of cities will be closed to private vehicles of limited utility as they are partly closed by parking restrictions to-day; and traffic signs and signals will be of increasing complexity. Mr. Watson proposes means of dealing with the congestion caused by public vehicles. This is a painstaking and practical analysis of traffic problems in the city, and the text is amplified by many useful photographs.

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